HANDBOOK of CHEMISTRY and PHYSICS

HODGMAN-LANGE

FOURTEENTH EDITION

TAYLOR SMITH, M.D.
35790 DETROIT RD.
AVON, OHIO

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HANDBOOK
OF
CHEMISTRY AND PHYSICS

A READY-REFERENCE POCKET BOOK
OF CHEMICAL AND PHYSICAL DATA

FOURTEENTH EDITION

COMPILED FROM THE MOST RECENT AUTHORITATIVE SOURCES

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PREFACE

THE Handbook of Chemistry and Physics, continuing the policy of the past, is being revised at frequent intervals.

The general features and scheme of arrangement, which have received extensive endorsement in former editions have been retained. The aim throughout has been to present in condensed form as large an amount of accurate, reliable and up-to-date informaton in the fields of chemistry and physics as was consistent with convenience in form and the possibility of wide utility and distribution. A very large proportion of the tables have been compiled especially for the Handbook from various authoritative collections of data and from the current journals.

Since the beginning special consideration has been given to the requests and suggestions of those who have used former editions. In this way it has been hoped to develop the book along lines most acceptable to those interested in a volume of this type. Suggestions have been received from more than a thousand members of high standing in the chemical and physical profession. We believe this coöperation to have been of very great value in the growth and development of the work.

An attempt has been made to include material on all branches of chemistry and physics and the closely allied sciences, which would be likely to find any extended use. On the other hand, in order to retain the convenience of moderate dimensions and at the same time allow for natural growth due to the extension of knowledge in these sciences, and logical additions along lines already developed, it has seemed necessary to exclude types of material of use only in certain highly specialized lines of work.

Chemistry and physics, always closely related sciences, have been brought into much more intimate relations by the more recent developments of research. To an increasing extent the student of either science should have a knowledge of the other. It would seem that there should be a large field for a single volume containing the constants and formulæ of the two sciences together with mathematical and conversion tables adequate for

accurate computation. The generous response which the previous editions have met indicates that the volumes have been found useful and it is with the hope of even more completely meeting the needs of the chemists and physicists of the English-speaking world that succeeding editions are offered.

CHEMICAL RUBBER PUBLISHING CO.

CLEVELAND, OHIO

PREFACE TO FOURTEENTH EDITION

With the increased demand for the Handbook in this country and abroad, have come many requests for scientific data not found in previous editions. As a result a very large variety of new material appears for the first time in this edition.

Chief among these additions is an entirely new table of the wave lengths of the principal lines in the emission spectra of the elements produced by the ark, spark or Geissler Tube. The intensities of lines are indicated by the numbers one to ten, the latter, the higher intensity. Other characteristics of the lines are indicated by symbols.

The section on ceramics has been enlarged by the addition of shrinkage conversion tables; tables giving the properties of dry and saturated air; weights of saturated and partly saturated air for various barometric conditions; altitude and temperature density tables and corresponding pressures and velocities of dry air.

Among other additions of special interest are the tables of transmission of ultra violet and infra red radiation by various neutral and colored glasses.

Tables have been added on the heat of formation and the heat of combustion of organic compounds and the combustion constants for gases and the heat of combination and combustion of representative coals.

For the lacquer and varnish manufacturers, a table has been introduced giving the physical and chemical constants of resins, oleo resins and gum resins.

In addition tables of coefficients of thermal expansion of metals and other substances, new and revised tables on the density of the elements, a much enlarged table on the physical constants of common minerals, percentage composition of anti-freeze solutions, a table of constant humidity of many compounds, special tables on the conversion of thermometer scales, and a much enlarged table of indicators have been added. Mention should also be made of several pages of

equations of representative qualitative volumetric reactions with gravimetric equivalents.

The Mathematical section has been enlarged by the addition of a table of anti-logarithms and complete simple and compound interest tables.

The following have acted as collaborators in the revision of the Handbook and in suggesting and compiling the new data in this edition:

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ANTIDOTES OF POISONS

Acetic Acid.—Emetics, magnesia, chalk, soap, oil.

Arsenic, Rat Poison, Paris Green.—Milk, raw egg, sweet oil, lime water, flour and water.

Carbolic Acid.—Any soluble non-toxic sulfate, after provoking vomiting with zinc sulfate; uncooked white of egg in abundance, milk of lime, saccharate of calcium, olive or castor oil with magnesia in suspension, ice, washing the stomach with equal parts water and vinegar; give alcohol or whiskey or about four fluid ounces camphorated oil at one dose.

Chloroform, Chloral, Ether.—Dash cold water on head and chest, artificial respiration.

Hydrochloric Acid.—Magnesia, alkali carbonates, albumen, ice.

Hydrocyanic or Prussic Acid.—Hydrogen peroxide internally, and artificial respiration, breathing ammonia or chlorine from chlorinated lime, ferrous sulfate followed by potassium carbonate, emetics, warmth.

Iodine.—Emetics, stomach siphon, starchy foods in abundance, sodium thiosulfate.

Lead Acetate.—Emetics, stomach siphon, sodium, potassium or magnesium sulfates, milk, albumen.

Mercuric Chloride or Corrosive Sublimate.—Zinc sulfate, emetics, stomach siphon, white of egg, milk, chalk, castor oil, table salt, reduced iron.

Nitrate of Silver.—Salt and water.

Nitric Acid.—Same as for hydrochloric acid.

Opium, Morphine, Laudanum, Paregoric, etc.—Strong coffee, hot bath. Keep awake and moving at any cost.

Phosphoric Acid.—Same as for hydrochloric.

Sodium Hydroxide or Potassium Hydroxide.—Vinegar, lemon juice, orange juice, oil, milk.

Sulfuric Acid.—Same as for hydrochloric acid with the addition of soap or oil.

Sulfurous Acid or Sulfur Dioxide.—Mustard plaster on chest; narcotics, expectorants.

BURNS AND SCALDS

Exclude air by thin paste of starch, flour, or baking soda Ordinary oils such as vaseline, olive or castor oil, lard or crean may also be used. Lime water mixed with an equal part c raw linseed oil makes an excellent dressing. An especially valu able material for all burns is picric acid gauze which may b applied in the form of a compress.

After treatment with any of the above materials, cover witl a cloth or with cotton and hold in place with a light bandage.

ACID AND ALKALI BURNS

With either, wash off as quickly as possible with a larg quantity of water. Water from a tap may be allowed to flo over burns.

Acids

While the injury is being washed, have procured, lime wate or lime water and raw linseed oil mixed together in equal pro portions or a mixture of baking soda and water or soap suds an apply freely. For acid in the eye wash as quickly as possibl with water and then with lime water.

Alkalis

Wash with a large quantity of water as for acid burns. Neutral ize with weak vinegar, hard cider or lemon juice. For lime o other strong alkali burns in the eye wash with weak solution o vinegar or with olive oil or a saturated solution of boric acid.

FIRE PRECAUTIONS AND CHEMICAL HAZARDS

Acetone.—Dilute with a spray of water to avoid spread of burning liquid. Use suitable gas mask.

Alcohol.—See under acetone.

Ammonia.—Use water and dilute acid. Use suitable gas mask.

Benzol or Benzene.—Use water to cool containers which are endangered; extinguish flame with sand, earth, fire-foam or carbon tetrachloride fire extinguishers. Use suitable gas mask.

Calcium Carbide.—Do not use water as this generates acetylene, an inflamable and explosive gas; cut off electric current to avoid ignition of gas. Remove containers to a dry place. Use gas mask.

Carbon Disulfide.—Use water to cool containers which are endangered; extinguish blaze with sand, earth, fire-foam or carbon tetrachloride fire extinguishers. Use suitable gas mask.

Celluloid.—Use large volumes of water and sand. The smoke contains oxides of nitrogen which are injurious. Use suitable gas mask.

Chlorine.—Spray with water. The pungent nature of the gas makes the use of a gas mask imperative.

Collodion.—See under carbon disulfide.

Ether.—See under carbon disulfide.

Gasoline.—See under carbon disulfide.

Hydrochloric Acid.—Use large volumes of water also chalk or soda. Use gas mask.

Hydrocyanic or Prussic Acid.—Suitable gas mask is essential because of the extremely poisonous nature of the vapors. Provide ventilation.

Lacquer Solvents.—See under carbon disulfide.

Magnesium.—Do not use water. Use sand or earth to extinguish flames. Remove containers to a dry place.

Nitric Acid and Oxides of Nitrogen.—Use large volumes of water. Do not use sand or earth. Use gas mask.

Potassium.—Do not use water. Remove containers to a dry place. Extinguish flames with sand or earth. For storage, potassium is kept immersed in petroleum.

Potassium Hydroxide.—Use large volumes of water or dilute acids.

Phosphorous.—Use water and wet sand. Use gas mas
For storage, white phosphorous must be kept immersed i
water. Red phosphorous is less dangerous.

Sodium.—See under potassium.

Sodium Hydroxide.—See under potassium hydroxide.

Sulfur.—Extinguish with water or sand. Use gas mask.

Sulfuric Acid.—See under hydrochloric acid.

Turpentine.—See under acetone.

MATHEMATICAL TABLES

ALGEBRA

Factors and Expansions

$$(a \pm b)^2 = a^2 \pm 2ab + b^2.$$
$$(a \pm b)^3 = a^3 \pm 3a^2b + 3ab^2 \pm b^3.$$
$$(a \pm b)^4 = a^4 \pm 4a^3b + 6a^2b^2 \pm 4ab^3 + b^4.$$
$$a^2 - b^2 = (a - b)(a + b).$$
$$a^2 + b^2 = (a + b\sqrt{-1})(a - b\sqrt{-1}).$$
$$a^3 - b^3 = (a - b)(a^2 + ab + b^2).$$
$$a^3 + b^3 = (a + b)(a^2 - ab + b^2).$$
$$a^4 + b^4 = (a^2 + ab\sqrt{2} + b^2)(a^2 - ab\sqrt{2} + b^2).$$
$$a^n - b^n = (a - b)(a^{n-1} + a^{n-2}b + \ldots + b^{n-1}).$$
$$a^n - b^n = (a + b)(a^{n-1} - a^{n-2}b + \ldots - b^{n-1}),$$
for even values of n.
$$a^n + b^n = (a + b)\ (a^{n-1} - a^{n-2}b + \ldots + b^{n-1}),$$
for odd values of n.
$$a^4 + a^2b^2 + b^4 = (a^2 + ab + b^2)(a^2 - ab + b^2).$$
$$(a + b + c)^2 = a^2 + b^2 + c^2 + 2ab + 2ac + 2bc.$$
$$(a + b + c)^3 = a^3 + b^3 + c^3 + 3a^2(b + c) + 3b^2(a + c) + 3c^2(a + b) + 6abc.$$
$$(a + b + c + d + \ldots)^2 = a^2 + b^2 + c^2 + d^2 + \ldots + 2a(b + c + d + \ldots) + 2b(c + d + \ldots) + 2c(d + \ldots) + \ldots$$

See also under Series

Powers and Roots

$$a^x \times a^y = a^{(x+y)}. \qquad a^0 = 1. \qquad (ab)^x = a^x b^x.$$
$$\frac{a^x}{a^y} = a^{(x-y)}. \qquad a^{-x} = \frac{1}{a^x}. \qquad \left(\frac{a}{b}\right)^x = \frac{a^x}{b^x}.$$
$$(a^x)^y = a^{xy}. \qquad a^{\frac{1}{x}} = \sqrt[x]{a}. \qquad \sqrt[x]{ab} = \sqrt[x]{a}\,\sqrt[x]{b}.$$
$$\sqrt[x]{\sqrt[y]{a}} = \sqrt[xy]{a}. \qquad a^{\frac{x}{y}} = \sqrt[y]{a^x}. \qquad \sqrt[x]{\frac{a}{b}} = \frac{\sqrt[x]{a}}{\sqrt[x]{b}}.$$

Proportion

If $\dfrac{a}{b} = \dfrac{c}{d}$, then $\dfrac{a+b}{b} = \dfrac{c+d}{d}$,

$\dfrac{a-b}{b} = \dfrac{c-d}{d}$, $\dfrac{a-b}{a+b} = \dfrac{c-d}{c+d}$.

ALGEBRA (Continued)

Sums of Numbers

The sum of the first n numbers, —

$$\Sigma(n) = 1 + 2 + 3 + 4 + 5 \ldots . + n = \frac{n(n+1)}{2}$$

The sum of the squares of the first n numbers,

$$\Sigma(n^2) = 1^2 + 2^2 + 3^2 + 4^2 + 5^2 \ldots . + n^2 = \frac{n(n+1)(2n+1)}{6}$$

The sum of the cubes of the first n numbers,

$$\Sigma(n^3) = 1^3 + 2^3 + 3^3 + 4^3 + 5^3 \ldots . + n^3 = \frac{n^2(n+1)^2}{4}$$

Arithmetical Progression

If a is the first term; l, the last term; d, the common difference; n, the number of terms and s, the sum of n terms, —

$$l = a + (n-1)d$$

$$s = \frac{n}{2}(a + l)$$

$$s = \frac{n}{2}\{2a + (n-1)d\}$$

Geometrical Progression

If a is the first term; l, the last term; r, the common ratio; n, the number of terms and s, the sum of n terms, —

$$l = ar^{n-1}$$

$$s = \frac{a(r^n - 1)}{r - 1}$$

$$s = \frac{a(1 - r^n)}{1 - r}$$

If n is infinity and r^2 less than unity, —

$$s = \frac{a}{1 - r}$$

Permutations

If M denote the number of permutations of n things taken p at a time, —

$$M = n(n-1)\,(n-2)\,\ldots\,(n-p+1)$$

Combinations

If M denote the number of combinations of n things taken p at a time, —

$$M = \frac{n(n-1)(n-2)\ldots.(n-p+1)}{\lfloor p}$$

$$M = \frac{\lfloor n}{\lfloor p \,\lfloor n-p}$$

ALGEBRA (Continued)

Quadratic Equations

Any quadratic equation may be reduced to the form, —

$$ax^2 + bx + c = 0$$

Then $$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}.$$

If $b^2 - 4ac$ is positive the roots are real and unqual.
If $b^2 - 4ac$ is zero the roots are real and equal.
If $b^2 - 4ac$ is negative the roots are imaginary and unequal.
If $b^2 - 4ac$ is a perfect square the roots are rational and unequal.

Cubic Equations

A cubic equation, $y^3 + py^2 + qy + r = 0$ may be reduced to the form, —

$$x^3 + ax + b = 0$$

by substituting for y the value, $x - \frac{p}{3}$. Here

$$a = \tfrac{1}{3}(3q - p^2) \text{ and } b = \tfrac{1}{27}(2p^3 - 9pq + 27r).$$

For solution let, —

$$A = \sqrt[3]{-\frac{b}{2} + \sqrt{\frac{b^2}{4} + \frac{a^3}{27}}}, \qquad B = \sqrt[3]{-\frac{b}{2} - \sqrt{\frac{b^2}{4} + \frac{a^3}{27}}},$$

then the values of x will be given by,

$$x = A + B, \quad -\frac{A+B}{2} + \frac{A-B}{2}\sqrt{-3}, \quad -\frac{A+B}{2} - \frac{A-B}{2}\sqrt{-3}$$

If $\frac{b^2}{4} + \frac{a^3}{27} > 0$, there will be one real root and two conjugate imaginary roots.

If $\frac{b^2}{4} + \frac{a^3}{27} = 0$, there will be three real roots of which two are equal.

If $\frac{b^2}{4} + \frac{a^3}{27} < 0$, there will be three real and unequal roots.

In the last case a trigonometric solution is useful. Compute the value of the angle ϕ in the expression, —

$$\cos\phi = \sqrt{\frac{b^2}{4} \div \left(-\frac{a^3}{27}\right)},$$

then x will have the following values: —

$$\mp 2\sqrt{-\frac{a}{3}}\cos\frac{\phi}{3}, \qquad \mp 2\sqrt{-\frac{a}{3}}\cos\left(\frac{\phi}{3} + 120°\right),$$

$$\mp 2\sqrt{-\frac{a}{3}}\cos\left(\frac{\phi}{3} + 240°\right).$$

ALGEBRA (Continued)

Approximations

If a and b are small quantities, the following relations are approximately true, —

$$(1 \pm a)^m = 1 \pm ma$$
$$(1 \pm a)^m(1 \pm b)^n = 1 \pm ma \pm nb$$

If n is nearly equal to m,

$$\sqrt{mn} = \frac{n+m}{2}, \text{ approximately.}$$

If θ is a very small angle expressed in radians, —

$$\frac{\sin\theta}{\theta} = 1 \text{ and } \frac{\tan\theta}{\theta} = 1, \text{ approximately.}$$

Series

The expression in parentheses following certain of the series indicates the region of convergence. If not otherwise indicated it is to be understood that the series converges for all finite values of x.

Binomial

$$(x+y)^n = x^n + nx^{n-1}y + \frac{n(n-1)}{\lfloor 2}x^{n-2}y^2 + \ldots .$$

$$\frac{n(n-1)\ldots(n-m+1)}{\lfloor m}x^{(n-m)}y^m + \cdots \quad (y^2 < x^2)$$

$$(1 \pm x)^n = 1 \pm nx + \frac{n(n-1)x^2}{\lfloor 2} \pm \frac{n(n-1)(n-2)x^3}{\lfloor 3} + \ldots \text{ etc.} \quad (x^2 < 1)$$

$$(1 \pm x)^{-n} = 1 \mp nx + \frac{n(n+1)x^2}{\lfloor 2} \mp \frac{n(n-1)(n-2)x^3}{\lfloor 3} + \ldots \text{ etc.} \quad (x^2 < 1)$$

$$(1 \pm x)^{-1} = 1 \mp x + x^2 \mp x^3 + x^4 \mp x^5 + \ldots \quad (x^2 < 1)$$

$$(1 \pm x)^{-2} = 1 \mp 2x + 3x^2 \mp 4x^3 + 5x^4 \mp 6x^5 + \ldots \quad (x^2 < 1)$$

Taylor's Series

$$f(x+h) = f(x) + hf'(x) + \frac{h^2}{\lfloor 2}f''(x) + \frac{h^3}{\lfloor 3}f'''(x) + \ldots$$

$$= f(h) + xf'(h) + \frac{x^2}{\lfloor 2}f''(h) + \frac{x^3}{\lfloor 3}f'''(h) + \ldots$$

Maclaurin's Series

$$f(x) = f(o) + xf'(o) + \frac{x^2}{\lfloor 2}f''(o) + \frac{x^3}{\lfloor 3}f'''(o) + \ldots$$

Exponential

$$e = 1 + \frac{1}{1} + \frac{1}{\lfloor 2} + \frac{1}{\lfloor 3} + \frac{1}{\lfloor 4} + \ldots$$

$$e^x = 1 + x + \frac{x^2}{\lfloor 2} + \frac{x^3}{\lfloor 3} + \frac{x^4}{\lfloor 4} + \ldots$$

$$a^x = 1 + x\log a + \frac{(x\log a)^2}{\lfloor 2} + \frac{(x\log a)^3}{\lfloor 3} + \ldots$$

ALGEBRA (Continued)

Logarithmic

$$\log_e x = \frac{x-1}{x} + \frac{1}{2}\left(\frac{x-1}{x}\right)^2 + \frac{1}{3}\left(\frac{x-1}{x}\right)^3 + \dots \qquad (x > \tfrac{1}{2})$$

$$\log_e x = (x-1) - \tfrac{1}{2}(x-1)^2 + \tfrac{1}{3}(x-1)^3 - \dots \qquad (2 > x > 0)$$

$$\log_e x = 2\left[\frac{x-1}{x+1} + \frac{1}{3}\left(\frac{x-1}{x+1}\right)^3 + \frac{1}{5}\left(\frac{x-1}{x+1}\right)^5 + \dots\right] \qquad (x > 0)$$

$$\log_e (1+x) = x - \tfrac{1}{2}x^2 + \tfrac{1}{3}x^3 - \tfrac{1}{4}x^4 + \dots \qquad (-1 < x < 1)$$

$$\log_e(n+1) - \log_e(n-1) = 2\left[\frac{1}{n} + \frac{1}{3n^3} + \frac{1}{5n^5} + \dots\right]$$

$$\log_{10}(n+1) - \log_{10} n = \frac{k}{n} + \frac{k}{2n^2} + \frac{k}{3n^3} + \dots \quad \text{where } k = .4343\dots$$

$$\log_e(a+x) = \log_e a + 2\left[\frac{x}{2a+x} + \frac{1}{3}\left(\frac{x}{2a+x}\right)^3 + \frac{1}{5}\left(\frac{x}{2a+x}\right)^5 + \dots\right] \qquad (a > 0,\ -a < x < +\infty)$$

Trigonometric

$$\sin x = x - \frac{x^3}{\lfloor 3} + \frac{x^5}{\lfloor 5} - \frac{x^7}{\lfloor 7} + \dots$$

$$\cos x = 1 - \frac{x^2}{\lfloor 2} + \frac{x^4}{\lfloor 4} - \frac{x^6}{\lfloor 6} + \dots$$

$$\tan x = x + \frac{x^3}{3} + \frac{2x^5}{15} + \frac{17x^7}{315} + \frac{62x^9}{2835} + \dots \qquad \left(x^2 < \frac{\pi^2}{4}\right)$$

$$\sin^{-1} x = x + \frac{x^3}{6} + \frac{1}{2}\cdot\frac{3}{4}\cdot\frac{x^5}{5} + \frac{1}{2}\cdot\frac{3}{4}\cdot\frac{5}{6}\cdot\frac{x^7}{7} + \dots \qquad (x^2 < 1)$$

$$\tan^{-1} x = x - \tfrac{1}{3}x^3 + \tfrac{1}{5}x^5 - \tfrac{1}{7}x^7 + \dots \qquad (x^2 < 1)$$

$$= \frac{\pi}{2} - \frac{1}{x} + \frac{1}{3x^3} - \frac{1}{5x^5} + \dots \qquad (x^2 > 1)$$

$$\log_e \sin x = \log_e x - \frac{x^2}{6} - \frac{x^4}{180} - \frac{x^6}{2835} - \dots \qquad (x^2 < \pi^2)$$

$$\log_e \cos x = -\frac{x^2}{2} - \frac{x^4}{12} - \frac{x^6}{45} - \frac{17x^8}{2520} - \dots \qquad \left(x^2 < \frac{\pi^2}{4}\right)$$

$$\log_e \tan x = \log_e x + \frac{x^2}{3} + \frac{7x^4}{90} + \frac{62x^6}{2835} + \dots \qquad \left(x^2 < \frac{\pi^2}{4}\right)$$

$$e^{\sin x} = 1 + x + \frac{x^2}{\lfloor 2} - \frac{3x^4}{\lfloor 4} - \frac{8x^5}{\lfloor 5} + \frac{3x^6}{\lfloor 6}$$

$$e^{\cos x} = e\left(1 - \frac{x^2}{\lfloor 2} + \frac{4x^4}{\lfloor 4} - \frac{31x^6}{\lfloor 6} + \dots\right)$$

$$e^{\tan x} = 1 + x + \frac{x^2}{\lfloor 2} + \frac{3x^3}{\lfloor 3} + \frac{9x^4}{\lfloor 4} + \frac{37x^5}{\lfloor 5} + \dots \qquad \left(x^2 < \frac{\pi^2}{4}\right)$$

MENSURATION FORMULÆ

Plain Figures Bounded by Straight Lines

The area of a **triangle** whose base is b and altitude h

$$= \frac{hb}{2}.$$

The area of a **triangle** with angles A, B, and C and sides opposite a, b, and c, respectively

$$= \tfrac{1}{2}ab \sin C.$$

or

$$= \sqrt{s(s-a)(s-b)(s-c)},$$

where $s = \tfrac{1}{2}(a+b+c)$.

A **rectangle** with sides a and b has an area $= ab$.

The area of a **parallelogram** with side b and the perpendicular distance to the parallel side h

$$= bh.$$

The area of a **parallelogram** with sides a and b and the included angle θ

$$= ab \sin \theta.$$

The area of a **rhombus** with diagonals c and d,

$$= \tfrac{1}{2}cd.$$

The area of a **trapezoid** whose parallel sides are a and b and altitude h

$$= \tfrac{1}{2}(a+b)h$$

The area of any **quadrilateral** with diagonals a and b and the angle between them θ

$$= \tfrac{1}{2}ab \sin \theta.$$

The area of a **regular polygon** with n sides, each of length l,

$$= \tfrac{1}{4}nl^2 \cot \frac{180}{n}.$$

For a regular polygon of n sides, each side of length l, the radius of the **inscribed circle**,

$$= \frac{l}{2} \cot \frac{180}{n}.$$

The radius of the **circumscribed circle**,

$$= \frac{l}{2} \operatorname{cosec} \frac{180}{n}.$$

Area, Radius of Inscribed and Circumscribed Circles for Regular Polygons

l = length of one side.

Name.	Number of sides.	Area.	Radius of inscribed circle.	Radius of circumscribed circle.
Triangle, equilateral	3	$0.43301l^2$	$0.28867l$	$0.57735l$
Square	4	$1.00000l^2$	$0.50000l$	$0.70710l$
Pentagon	5	$1.72048l^2$	$0.68819l$	$0.85065l$
Hexagon	6	$2.59808l^2$	$0.86602l$	$1.0000l$
Heptagon	7	$3.63391l^2$	$1.0383l$	$1.1523l$
Octagon	8	$4.82843l^2$	$1.2071l$	$1.3065l$
Nonagon	9	$6.18182l^2$	$1.3737l$	$1.4619l$
Decagon	10	$7.69421l^2$	$1.5388l$	$1.6180l$
Undecagon	11	$9.36564l^2$	$1.7028l$	$1.7747l$
Dodecagon	12	$11.19615l^2$	$1.8660l$	$1.9318l$

Radius of circle inscribed in any triangle, whose sides are a, b, and c, where $s = \frac{1}{2}(a + b + c)$

$$= \frac{\sqrt{s(s-a)(s-b)(s-c)}}{s}.$$

The radius of the **circumscribed** circle

$$= \frac{abc}{4\sqrt{s(s-a)(s-b)(s-c)}}.$$

The perimeter of a polygon inscribed in a circle of radius r, where n is the number of sides,

$$= 2nr \sin\frac{\pi}{n}. \qquad (\pi \text{ radians} = 180°)$$

The area of the inscribed polygon,

$$= \tfrac{1}{2}nr^2 \sin\frac{2\pi}{n}.$$

The perimeter of a polygon circumscribed about a circle of radius r, number of sides n

$$= 2nr \tan\frac{\pi}{n}.$$

The area of the **circumscribed** polygon

$$= nr^2 \tan\frac{\pi}{n}.$$

Plane Figures Bounded by Curved Lines

The **circumference of a circle** whose radius is r and diameter $d(d = 2r)$

$$= 2\pi r = \pi d. \qquad (\pi = 3.14159)$$

The **area of a circle**

$$= \pi r^2 = \tfrac{1}{4}\pi d^2 = .7854 d^2.$$

The **length of an arc** of a circle for an arc of θ degrees

$$= \frac{\pi r \theta}{180}.$$

NOTE. — In this and following similar formulæ r denotes the radius of the circle, (OC, Fig. 1).

For an arc of θ radians the length

$$= r\theta.$$

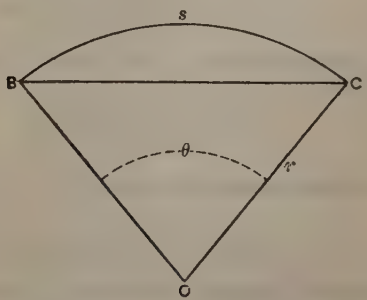

FIG. 1.

The **length of a chord** subtending an angle θ

$$= 2r \sin \tfrac{1}{2}\theta.$$

The **area of a sector** where θ is the angle between the radi in degrees

$$= \frac{\pi r^2 \theta}{360}.$$

If s is the length of the arc, the area of the sector

$$= \frac{sr}{2}.$$

The **area of a segment** where θ is the angle between the tw radii in degrees

$$= \frac{\pi r^2 \theta}{360} - \frac{r^2 \sin \theta}{2}.$$

If θ is in radians the area

$$= \tfrac{1}{2}r^2(\theta - \sin\theta).$$

The **area of the ring** between two circles of radius r_1 and r_2, one of which encloses the other,

$$= \pi(r_1 + r_2)(r_1 - r_2).$$

The two circles are not necessarily concentric.

Area of the sector of an annulus. (Fig. 2.) — If angle $GOH = \theta$ and the lines GO and $JO = r^1$ and r^2 respectively, the area $GHIJ$

$$= \tfrac{1}{2}\theta(r_1 + r_2)(r_1 - r_2).$$

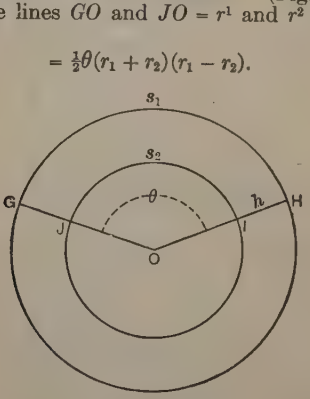

FIG. 2.

If $s_1 =$ the length of the arc GH and $s_2 =$ the arc JI and $h = HI = r_1 - r_2$, the area $GHIJ$

$$= \tfrac{1}{2}h(s_1 + s_2).$$

The **circumference of an ellipse** whose semiaxes are a and b

$$= 2\pi\sqrt{\frac{a^2 + b^2}{2}}, \text{ approximately.}$$

The **area of an ellipse**

$$= \pi ab.$$

The length of the **arc of a parabola**, as arc SPQ in Fig. 3, where $x = PR$, and $y = QR$

$$= 2\sqrt{y^2 + \frac{4x^2}{3}}.$$

The **area of the section of the parabola** $PQRS$,

$$= \tfrac{4}{3}xy.$$

Solids Bounded by Planes

The lateral area of a regular prism = perimeter of a right section × the length.

The volume of a regular prism = area of base × the altitude.

The lateral area of a regular pyramid, slant height l, length of one side of base a, and a number of sides n,

$$= \tfrac{1}{2}nal.$$

The volume of a pyramid = $\frac{1}{3}$ area of base × altitude.

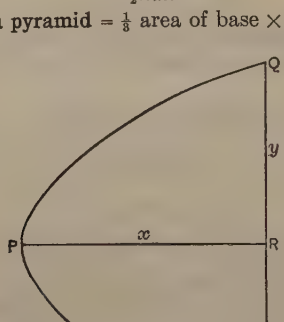

FIG. 3.

Surface and Volume of Regular Polyhedra

Surface and volume of regular polyhedra in terms of the length of one edge l.

Name.	Nature of surface.	Surface.	Volume.
Tetrahedron...	4 equilateral triangles	$1.73205l^2$	$0.11785l^3$
Hexahedron or cube	6 squares.....	$6.00000l^2$	$1.00000l^3$
Octahedron....	8 equilateral triangles	$3.46410l^2$	$0.47140l^3$
Dodecahedron .	12 pentagons.....	$20.64578l^2$	$7.66312l^3$
Icosahedron ...	20 equilateral triangles	$8.66025l^2$	$2.18170l^3$

Solids Bounded by Curved Surfaces

The surface of a sphere of radius r and diameter $d(=2r)$

$$= 4\pi r^2 = \pi d^2 = 12.57r^2.$$

The volume of a sphere

$$= \tfrac{4}{3}\pi r^3 = \tfrac{1}{6}\pi d^3 = 4.189r^3.$$

The **area of a lune** on the surface of a sphere of radius r, included between two great circles whose inclination is θ radians

$$= 2r^2\theta.$$

The **area of a spherical triangle** whose angles are A, B, and C (radians) on a sphere of radius r

$$= (A + B + C - \pi)r^2.$$

The **area of a spherical polygon** of n sides where θ is the sum of its angles in radians

$$= [\theta - (n - 2)\pi]r^2.$$

The area of the curved surface of a **spherical segment** of height h, radius of sphere r

$$= 2\pi rh.$$

The **volume of a spherical segment,** data as above

$$= \tfrac{1}{3}\pi h^2(3r - h).$$

If a = radius of the base of the segment, the volume

$$= \tfrac{1}{6}\pi h(h^2 + 3a^2).$$

The **curved surface of a right cylinder** where r = the radius of the base and h, the altitude,

$$= 2\pi rh.$$

The **volume of a cylinder,** data as above,

$$= \pi r^2 h.$$

The **curved surface of a right cone** whose altitude is h and radius of base r

$$= \pi r\sqrt{r^2 + h^2}.$$

The **volume of a cone,** data as above,

$$= \frac{\pi}{3}r^2h = 1.047r^2h.$$

The **curved surface of the frustum of a right cone,** radius of base r_1, of top r_2 and altitude h,

$$= \pi(r_1 + r_2)\sqrt{h^2 + (r_1^2 - r_2^2)}.$$

The **volume of the frustum of a cone,** data as above,

$$= \pi\frac{h}{3}(r_1^2 + r_1r_2 + r_2^2).$$

The **oblate spheroid** is formed by the rotation of an ellipse about its minor axis. If a and b are the major and minor semi axes respectively, and e the eccentricity, the surface

$$= 2\pi a^2 + \pi\frac{b^2}{e}\log_e\frac{1 + e}{1 - e},$$

and volume $= \tfrac{4}{3}\pi a^2 b.$

The **prolate spheroid** is formed by the rotation of an ellipse about its major axis ($2a$), data as above.

Surface $= 2\pi b^2 + 2\pi \frac{ab}{e} \sin^{-1} e,$

volume $= \frac{4}{3}\pi ab^2.$

TRIGONOMETRIC FUNCTIONS IN A RIGHT-ANGLED TRIANGLE

If A, B, and C are the vertices (C the right angle), and a, b, and h the sides opposite respectively,

$\sin A = \frac{a}{h}$, $\quad \cos A = \frac{b}{h}$,

$\tan A = \frac{a}{b}$, $\quad \cot A = \frac{b}{a}$,

$\text{secant } A = \frac{h}{b}$, $\quad \text{cosec } A = \frac{h}{a}$.

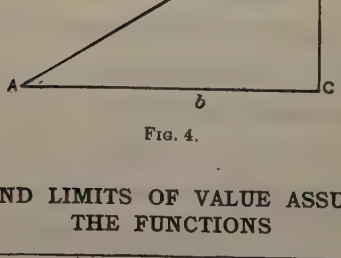

FIG. 4.

SIGNS AND LIMITS OF VALUE ASSUMED BY THE FUNCTIONS

Function.	Quadrant I.		Quadrant II.		Quadrant III.		Quadrant IV.	
	Sign.	Value.	Sign.	Value.	Sign.	Value.	Sign.	Value.
sin.....	+	0 to 1	+	1 to 0	−	0 to 1	−	1 to 0
cos.....	+	1 to 0	−	0 to 1	−	1 to 0	+	0 to 1
tan.....	+	0 to ∞	−	∞ to 0	+	0 to ∞	−	∞ to 0
cot.....	+	∞ to 0	−	0 to ∞	+	∞ to 0	−	0 to ∞
sec.....	+	1 to ∞	−	∞ to 1	−	1 to ∞	+	∞ to 1
cosec...	+	∞ to 1	+	1 to ∞	−	∞ to 1	−	1 to ∞

VALUE OF THE FUNCTIONS OF VARIOUS ANGLES

	0°	30°	45°	60°	90°	180°	270°
sin.....	0	$\frac{1}{2}$	$\frac{1}{2}\sqrt{2}$	$\frac{1}{2}\sqrt{3}$	1	0	−1
cos.....	1	$\frac{1}{2}\sqrt{3}$	$\frac{1}{2}\sqrt{2}$	$\frac{1}{2}$	0	−1	0
tan.....	0	$\frac{1}{3}\sqrt{3}$	1	$\sqrt{3}$	∞	0	∞
cot.....	∞	$\sqrt{3}$	1	$\frac{1}{3}\sqrt{3}$	0	∞	0

RELATIONS OF THE FUNCTIONS

$$\sin x = \frac{1}{\operatorname{cosec} x}. \qquad \operatorname{cosec} x = \frac{1}{\sin x}.$$

$$\cos x = \frac{1}{\sec x}. \qquad \sec x = \frac{1}{\cos x}.$$

$$\tan x = \frac{1}{\cot x} = \frac{\sin x}{\cos x}.$$

$$\cot x = \frac{1}{\tan x} = \frac{\cos x}{\sin x}.$$

$$\sin x = \sqrt{1 - \cos^2 x}. \qquad \cos x = \sqrt{1 - \sin^2 x}.$$

$$\tan x = \sqrt{\sec^2 x - 1}. \qquad \sec x = \sqrt{\tan^2 x + 1}.$$

$$\cot x = \sqrt{\operatorname{cosec}^2 x - 1}. \qquad \operatorname{cosec} x = \sqrt{\cot^2 x + 1}.$$

$$\sin x = \cos (90 - x) = \sin (180 - x).$$

$$\cos x = \sin (90 - x) = -\cos (180 - x).$$

$$\tan x = \cot (90 - x) = -\tan (180 - x).$$

$$\cot x = \tan (90 - x) = -\cot (180 - x).$$

FUNCTIONS OF SUMS OF ANGLES

$$\sin (x + y) = \sin x \cos y + \cos x \sin y.$$

$$\sin (x - y) = \sin x \cos y - \cos x \sin y.$$

$$\cos (x + y) = \cos x \cos y - \sin x \sin y.$$

$$\cos (x - y) = \cos x \cos y + \sin x \sin y.$$

$$\tan (x + y) = \frac{\tan x + \tan y}{1 - \tan x \tan y}.$$

$$\tan (x - y) = \frac{\tan x - \tan y}{1 + \tan x \tan y}.$$

FUNCTIONS OF MULTIPLE ANGLES

$$\sin 2x = 2 \sin x \cos x.$$
$$\cos 2x = \cos^2 x - \sin^2 x = 2 \cos^2 x - 1 = 1 - 2 \sin^2 x.$$
$$\sin 3x = 3 \sin x - 4 \sin^3 x.$$
$$\cos 3x = 4 \cos^3 x - 3 \cos x.$$
$$\sin 4x = 8 \cos^3 x \sin x - 4 \cos x \sin x.$$
$$\cos 4x = 8 \cos^4 x - 8 \cos^2 x + 1.$$
$$\sin 5x = 5 \sin x - 20 \sin^3 x + 16 \sin^5 x.$$
$$\cos 5x = 16 \cos^5 x - 20 \cos^3 x + 5 \cos x.$$
$$\sin 6x = 32 \cos^5 x \sin x - 32 \cos^3 x \sin x + 6 \cos x \sin x.$$
$$\cos 6x = 32 \cos^6 x - 48 \cos^4 x + 18 \cos^2 x - 1.$$

$$\tan 2x = \frac{2 \tan x}{1 - \tan^2 x}.$$

$$\cot 2x = \frac{\cot^2 x - 1}{2 \cot x}.$$

$$\tan 3x = \frac{3 \tan x - \tan^3 x}{1 - 3 \tan^2 x}.$$

$$\sin \tfrac{1}{2}x = \pm \sqrt{\frac{1 - \cos x}{2}}.$$

$$\cos \tfrac{1}{2}x = \pm \sqrt{\frac{1 + \cos x}{2}}.$$

$$\tan \tfrac{1}{2}x = \pm \sqrt{\frac{1 - \cos x}{1 + \cos x}} = \frac{1 - \cos x}{\sin x} = \frac{\sin x}{1 + \cos x}.$$

MISCELLANEOUS RELATIONS

$$\sin x \pm \sin y = 2 \sin \tfrac{1}{2}(x \pm y) \cdot \cos \tfrac{1}{2}(x \mp y).$$
$$\cos x + \cos y = 2 \cos \tfrac{1}{2}(x + y) \cdot \cos \tfrac{1}{2}(x - y).$$
$$\cos x - \cos y = -2 \sin \tfrac{1}{2}(x + y) \cdot \sin \tfrac{1}{2}(x - y).$$

$$\tan x \pm \tan y = \frac{\sin (x \pm y)}{\cos x \cdot \cos y}.$$

$$\cot x \pm \cot y = \frac{\pm \sin (x \pm y)}{\sin x \cdot \sin y}.$$

$$\frac{\sin x \pm \sin y}{\cos x + \cos y} = \tan \tfrac{1}{2}(x \pm y).$$

$$\frac{\sin x \pm \sin y}{\cos x - \cos y} = -\cot \tfrac{1}{2}(x \mp y).$$

$$\frac{\sin x + \sin y}{\sin x - \sin y} = \frac{\tan \tfrac{1}{2}(x + y)}{\tan \tfrac{1}{2}(x - y)}.$$

$$\sin^2 x - \sin^2 y = \sin (x + y) \cdot \sin (x - y).$$
$$\cos^2 x - \cos^2 y = -\sin (x + y) \sin (x - y).$$
$$\cos^2 x - \sin^2 y = \cos (x + y) \cos (x - y).$$

RELATIONS BETWEEN SIDES AND ANGLES OF ANY PLANE TRIANGLE

In a triangle with angles A, B, and C and sides opposite a, b, and c respectively,

$$\frac{\sin A}{a} = \frac{\sin B}{b} = \frac{\sin C}{c}.$$

$$a^2 = b^2 + c^2 - 2bc \cos A.$$

$$a = b \cos C + c \cos B.$$

$$\cos A = \frac{b^2 + c^2 - a^2}{2bc}.$$

$$\tan \frac{A - B}{2} = \frac{a - b}{a + b} \cot \frac{C}{2}.$$

$$\sin A = \frac{2}{bc} \sqrt{s(s-a)(s-b)(s-c)},$$

where $s = \frac{1}{2}(a + b + c)$.

$$\sin \frac{A}{2} = \sqrt{\frac{(s-b)(s-c)}{bc}}.$$

$$\cos \frac{A}{2} = \sqrt{\frac{s(s-a)}{bc}}.$$

$$\tan \frac{A}{2} = \sqrt{\frac{(s-b)(s-c)}{s(s-a)}}.$$

$$\frac{a+b}{a-b} = \frac{\sin A + \sin B}{\sin A - \sin B} = \frac{\tan \frac{1}{2}(A+B)}{\tan \frac{1}{2}(A-B)} = \frac{\cot \frac{1}{2} C}{\tan \frac{1}{2}(A-B)}.$$

RELATIONS IN ANY SPHERICAL TRIANGLE

If A, B and C be the three angles and a, b, and c the opposite sides,

$$\frac{\sin A}{\sin a} = \frac{\sin B}{\sin b} = \frac{\sin C}{\sin c}.$$

$$\cos a = \cos b \cos c + \sin b \sin c \cos A.$$

$$\cos A = -\cos B \cos C + \sin B \sin C \cos a.$$

$$\sin \tfrac{1}{2} A = \sqrt{\frac{\sin (s-b) \cdot \sin (s-c)}{\sin b \sin c}}$$

where $s = \frac{1}{2}(a + b + c)$.

$$\cos \tfrac{1}{2} A = \sqrt{\frac{\sin s \cdot \sin (s-a)}{\sin b \sin c}}.$$

$$\tan \tfrac{1}{2} A = \frac{r}{\sin (s-a)}$$

where $$r = \sqrt{\frac{\sin (s-a) \sin (s-b) \sin (s-c)}{\sin s}}.$$

$$\cos \tfrac{1}{2} a = \sqrt{\frac{\cos (S - B) \cos (S - C)}{\sin B \sin C}}$$

where $S = \tfrac{1}{2}(A + B + C)$.

$$\sin \tfrac{1}{2} a = \sqrt{-\frac{\cos S \cos (S - A)}{\sin B \sin C}}.$$

$$\tan \tfrac{1}{2} a = R \cos (S - A)$$

where $R = \sqrt{\dfrac{-\cos S}{\cos (S - A) \cos (S - B) \cos (S -$

CALCULUS

Differentials

$$d\,ax = a dx$$
$$d\,uv = u dv + v du$$
$$d\frac{u}{v} = \frac{v du - u dv}{v^2}$$
$$dx^n = n\,x^{n-1} dx$$
$$d\,e^x = e^x dx$$
$$d\,e^{ax} = a\,e^{ax} dx$$
$$d \log_e x = \frac{1}{x} dx$$
$$d\,x^x = x^x(1 + \log_e x)\,dx$$
$$d \sin x = \cos x\,dx$$
$$d \cos x = -\sin x\,dx$$
$$d \tan x = \sec^2 x\,dx$$
$$d \cot x = -\csc^2 x\,dx$$
$$d \sec x = \tan x \sec x\,dx$$
$$d \csc x = -\cot x \cdot \csc x\,dx$$
$$d \sin^{-1} x = (1 - x^2)^{-\frac{1}{2}} dx$$
$$d \cos^{-1} x = -(1 - x^2)^{-\frac{1}{2}} dx$$
$$d \tan^{-1} x = (1 + x^2)^{-1} dx$$
$$d \cot^{-1} x = -(1 + x^2)^{-1} dx$$
$$d \sec^{-1} x = x^{-1}(x^2 - 1)^{-\frac{1}{2}} dx$$
$$d \csc^{-1} x = -x^{-1}(x^2 - 1)^{-\frac{1}{2}} dx$$

Integrals

$$\int x^n\,dx = \frac{x^{n+1}}{n+1}. \qquad \text{except } n =$$

$$\int \frac{dx}{x} = \log x.$$

$$\int e^x\,dx = e^x$$

$$\int e^{ax} dx = \frac{1}{a} e^{ax}.$$

$$\int x\,e^{ax} dx = \frac{e^{ax}}{a^2}(ax - 1).$$

Integrals (Continued)

$$\int \log x\,dx = x\log x - x$$

$$\int u\,dv = uv - \int v\,du$$

$$\int (a+bx)^n dx = \frac{(a+bx)^{n+1}}{(n+1)b} \qquad \text{except } n = -1$$

$$\int \frac{dx}{a+bx} = \frac{1}{b}\log(a+bx)$$

$$\int \sqrt{x+bx}\,dx = \frac{2}{3b}\sqrt{(a+bx)^3}$$

$$\int x\sqrt{a+bx}\,dx = -\frac{2(2a-3bx)\sqrt{(a+bx)^3}}{15b^2}$$

$$\int x^2\sqrt{a+bx}\,dx = \frac{2(8a^2-12abx+15b^2x^2)\sqrt{(a+bx)^3}}{105b^3}$$

$$\int \frac{dx}{a^2+x^2} = \frac{1}{a}\tan^{-1}\frac{x}{a} = \frac{1}{a}\sin^{-1}\frac{x}{\sqrt{x^2+a^2}}$$

$$\int \frac{dx}{a^2-x^2} = \frac{1}{2a}\log\frac{a+x}{a-x}$$

$$\int \sqrt{a^2-x^2}\,dx = \frac{1}{2}\left[x\sqrt{a^2-x^2} + a^2\sin^{-1}\left(\frac{x}{a}\right)\right]$$

$$\int \frac{dx}{\sqrt{a^2-x^2}} = \sin^{-1}\frac{x}{a} = -\cos^{-1}\frac{x}{a}$$

$$\int \frac{x\,dx}{\sqrt{a^2 \pm x^2}} = \pm\sqrt{a^2 \pm x^2}$$

$$\int x\sqrt{a^2-x^2}\,dx = -\frac{1}{3}\sqrt{(a^2-x^2)^3}$$

$$\int x^2\sqrt{a^2-x^2}\,dx = -\frac{x}{4}\sqrt{(a^2-x^2)^3} + \frac{a^2}{8}\left(x\sqrt{a^2-x^2} + a^2\sin^{-1}\frac{x}{a}\right)$$

$$\int \frac{dx}{\sqrt{x^2 \pm a^2}} = \log(x + \sqrt{x^2 \pm a^2})$$

$$\int \sqrt{(x^2 \pm a^2)^3}\,dx = \frac{1}{4}\left[x\sqrt{(x^2 \pm a^2)^3} \pm \frac{3a^2x}{2}\sqrt{x^2 \pm a^2)} + \frac{3a^4}{2}\log(x + \sqrt{x^2 \pm a^2})\right]$$

$$\int \sqrt{(a^2-x^2)^3}\,dx = \frac{1}{4}\left[x\sqrt{(a^2-x^2)^3} + \frac{3a^2x}{2}\sqrt{a^2-x^2} + \frac{3a^4}{2}\sin^{-1}\frac{x}{a}\right]$$

$$\int \sqrt{2ax-x^2}\,dx = \frac{1}{2}\left[(x-a)\sqrt{2ax-x^2} + a^2\sin^{-1}\left(\frac{x-a}{a}\right)\right]$$

$$\int \frac{dx}{\sqrt{2ax-x^2}} = \cos^{-1}\left(\frac{a-x}{a}\right)$$

Integrals (Continued)

If $X = a + bx + cx^2$

$$\int \frac{dx}{\sqrt{X}} = \frac{1}{\sqrt{c}} \log \left(\sqrt{X} + x\sqrt{c} + \frac{b}{2\sqrt{c}} \right), \text{ if } c > 0$$

$$\int \frac{dx}{\sqrt{X}} = \frac{1}{\sqrt{-c}} \sin^{-1} \left(\frac{-2\,cx - b}{\sqrt{b^2 - 4ac}} \right), \text{ if } c < 0$$

$$\int x\sqrt{X}\, dx = \frac{X\sqrt{X}}{3c} - \frac{b}{2c} \int \sqrt{X}\, dx$$

$$\int \sin x\, dx = -\cos x$$

$$\int \sin^2 x\, dx = -\tfrac{1}{2} \cos x \sin x + \tfrac{1}{2}x$$

$$\int \sin^3 x\, dx = -\tfrac{1}{3} \cos x\, (\sin^2 x + 2)$$

$$\int x \sin x\, dx = \sin x - x \cos x$$

$$\int x^2 \sin x\, dx = 2x \sin x - (x^2 - 2) \cos x$$

$$\int \cos x\, dx = \sin x$$

$$\int \cos^2 x\, dx = \tfrac{1}{2} \sin x \cos x + \tfrac{1}{2}x$$

$$\int \cos^3 x\, dx = \tfrac{1}{3} \sin x\, (\cos^2 x + 2)$$

$$\int x \cos x\, dx = \cos x + x \sin x$$

$$\int x^2 \cos x\, dx = 2x \cos x + (x^2 - 2) \sin x$$

$$\int \tan x\, dx = -\log \cos x$$

$$\int \tan^2 x\, dx = \tan x - x$$

$$\int \cot x\, dx = \log \sin x$$

$$\int \cot^2 x\, dx = -\cot x - x$$

$$\int \sec x\, dx = \log \tan \left(\frac{\pi}{4} + \frac{x}{2} \right)$$

$$\int \sec^2 x\, dx = \tan x$$

$$\int \csc x\, dx = \log \tan \tfrac{1}{2}x$$

$$\int \csc^2 x\, dx = -\cot x$$

$$\int \sin x \cos x\, dx = \tfrac{1}{2} \sin^2 x$$

$$\int \frac{dx}{\sin x \cos x} = \log \tan x$$

$$\int \sin^2 x \cos^2 x\, dx = -\tfrac{1}{8}(\tfrac{1}{4} \sin 4x - x)$$

$$\int \sin^{-1} x\, dx = x \sin^{-1} x + \sqrt{1 - x^2}$$

$$\int \cos^{-1} x\, dx = x \cos^{-1} x - \sqrt{1 - x^2}$$

ANALYTICAL GEOMETRY

The distance between two points x_1, y_1, and x_2, y_2, — rectangular coördinates:

$$d = \pm \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

For polar coördinates and points r_1, θ_1, and r_2, θ_2:

$$d = \pm \sqrt{r_1^2 + r_2^2 - 2r_1r_2 \cos (\theta_1 - \theta)_2}$$

The area of a triangle whose vertices are x_1, y_1; x_2, y_2, and x_3, y_3:

$$A = \tfrac{1}{2}(x_1y_2 - x_2y_1 + x_2y_3 - x_3y_2 + x_3y_1 - x_1y_3)$$

For polar coördinates and vertices, r_1, θ_1; r_2, θ_2, and r_3, θ_3:

$$A = \tfrac{1}{2}\{(r_1r_2 \sin (\theta_2 - \theta_1) + r_2r_3 \sin (\theta_3 - \theta_2) + r_3r_1 \sin (\theta_1 - \theta_3)\}$$

The equation of a straight line where m is the tangent of the angle of inclination and c, the distance of intersection with the Y axis from the origin:

$$y = mx + c$$

If a line of inclination m passes through the point x_1, y_1 its equation is:

$$y - y_1 = m(x - x_1)$$

The equation of a line through the points x_1, y_1, and x_2, y_2 is:

$$\frac{y - y_1}{y_2 - y_1} = \frac{x - x_1}{x_2 - x_1}$$

If the intercepts on the X and Y axes are a and b respectively, the equation is:

$$\frac{x}{a} + \frac{y}{b} = 1$$

If the length of the perpendicular from the origin is p and its angle of inclination θ the equation is:

$$x \cos \theta + y \sin \theta = p$$

General equation of the straight line:

$$Ax + By + C = 0$$

The equation of a circle whose center is at a, b, and whose radius is c:

$$(x - a)^2 + (y - b)^2 = c^2$$

If the origin is at the center:

$$x^2 + y^2 = c^2$$

The polar equation of a circle with the origin on the circumference and its center at point c, α:

$$r = 2c \cos (\theta - \alpha).$$

If the origin is not on the circumference, the radius c and the center at a point l, α, the equation becomes:

$$a^2 = r^2 + l^2 - 2rl \cos (\theta - \alpha)$$

The equation of a parabola with the origin at the vertex, where p is the distance from the focus to the vertex:

$$y^2 = 4px$$

The polar equation where the pole is at the **focus** and l the semi-latus rectum is:

$$\frac{l}{r} = 1 - \cos\theta$$

If the pole is at the vertex and p as above:

$$r = \frac{4p\cos\theta}{\sin^2\theta}$$

The equation of the ellipse with the origin at the center and semi-axes a and b:

$$\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$$

Polar equation where the pole is at the center:

$$r^2 = \frac{a^2b^2}{a^2\sin^2\theta + b^2\cos^2\theta}$$

The equation of the hyperbola with the origin at the center, semi-axes a and b:

$$\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$$

Polar equation, pole at center:

$$r^2 = \frac{a^2b^2}{a^2\sin^2\theta - b^2\cos^2\theta}$$

EXPLANATION OF LOGARITHM TABLES

The logarithm of a number is the exponent of that power to which another number, the base, must be raised to give the number first named. The base commonly used is 10 and as most numbers are incommensurable powers of ten a common logarithm, in general, consists of an integer which is called the characteristic and an endless decimal, the mantissa.

It is to be observed that the common logarithms of all numbers expressed by the same figures in the same order with the decimal point in different positions have different characteristics but the same mantissa. To illustrate: — if the decimal point stand after the first figure of a number, counting from the left, the characteristic is 0; if after two figures, it is 1; if after three figures, it is 2, and so forth. If the decimal point stand before the

first significant figure the characteristic is -1, usually written $\bar{1}$; if there is one zero between the decimal point and the first significant figure it is $\bar{2}$ and so on. For example: log 256 = 2.40824, log 2.56 = 0.40824, log 0.256 = $\bar{1}$.40824, log 0.00256 = $\bar{3}$.40824. Inasmuch as the characteristic may be determined by inspection the mantissas only are given in tables of common logarithms.

To find the logarithm of a number.

For a number of four figures take out the tabular mantissa on a line with the first three figures of the number and under its fourth figure. The characteristic is determined as previously explained.

For a number of less than four figures supply zeros to make a four figure number and take the value of the mantissa from the tables as before. For example: log 2 = log 2.000 = 0.30103.

For a number of more than four figures take the tabular value of the mantissa for the first four figures; find the difference between this mantissa and the next greater tabular mantissa and multiply the difference so found by the remaining figures of the number as a decimal and add the product to the mantissa of the first four figures. For example: to find log 46.762.

log 46.76 = 1.66987

Tabular difference between this mantissa and that for 4677 is .00010.

$$\begin{aligned} \therefore \log 46.762 &= 1.66987 + .2 \times .00010 \\ &= 1.66987 + .00002 \\ &= 1.66989 \end{aligned}$$

To find the number corresponding to a given logarithm.

If the mantissa is found exactly in the table, join the figure at the top which is directly above the given mantissa to the three figures on the line at the left and place the decimal point according to the characteristic of the logarithm. For example, $\log^{-1}$ (antilogarithm) 3.39967 = 2510.

If the mantissa is not found exactly in the table it is necessary to interpolate. For example, $\log^{-1}$ 3.40028 = 2513. + $\frac{9}{18}$ = 2513.5.

The column of proportional parts at the right of each page of the table shows, under the heading of the various tabular differences, the parts of these differences which correspond to the digits from 1 to 9 in the fifth place. This makes it possible to take out a logarithm for a five figure number or to find an antilogarithm of the same number of significant figures with increased facility, usually by inspection.

The following formulæ express the relations on which the use of logarithms is based.

$$\log ab = \log a + \log b$$

$$\log \frac{a}{b} = \log a - \log b$$

$$\log a^n = n \times \log a$$

$$\log \sqrt[n]{a} = \frac{\log a}{n}$$

FOUR-PLACE LOGARITHMS

N	0	1	2	3	4	5	6	7	8	9	Proportional Parts 1	2	3	4	5
10	0000	0043	0086	0128	0170	0212	0253	0294	0334	0374	4	8	12	17	21
11	0414	0453	0492	0531	0569	0607	0645	0682	0719	0755	4	8	11	15	19
12	0792	0828	0864	0899	0934	0969	1004	1038	1072	1106	3	7	10	14	17
13	1139	1173	1206	1239	1271	1303	1335	1367	1399	1430	3	6	10	13	16
14	1461	1492	1523	1553	1584	1614	1644	1673	1703	1732	3	6	9	12	15
15	1761	1790	1818	1847	1875	1903	1931	1959	1987	2014	3	6	8	11	14
16	2041	2068	2095	2122	2148	2175	2201	2227	2253	2279	3	5	8	11	13
17	2304	2330	2355	2380	2405	2430	2455	2480	2504	2529	2	5	7	10	12
18	2553	2577	2601	2625	2648	2672	2695	2718	2742	2765	2	5	7	9	12
19	2788	2810	2833	2856	2878	2900	2923	2945	2967	2989	2	4	7	9	11
20	3010	3032	3054	3075	3096	3118	3139	3160	3181	3201	2	4	6	8	11
21	3222	3243	3263	3284	3304	3324	3345	3365	3385	3404	2	4	6	8	10
22	3424	3444	3464	3483	3502	3522	3541	3560	3579	3598	2	4	6	8	10
23	3617	3636	3655	3674	3692	3711	3729	3747	3766	3784	2	4	6	7	9
24	3802	3820	3838	3856	3874	3892	3909	3927	3945	3962	2	4	5	7	9
25	3979	3997	4014	4031	4048	4065	4082	4099	4116	4133	2	3	5	7	9
26	4150	4166	4183	4200	4216	4232	4249	4265	4281	4298	2	3	5	7	8
27	4314	4330	4346	4362	4378	4393	4409	4425	4440	4456	2	3	5	6	8
28	4472	4487	4502	4518	4533	4548	4564	4579	4594	4609	2	3	5	6	8
29	4624	4639	4654	4669	4683	4698	4713	4728	4742	4757	1	3	4	6	7
30	4771	4786	4800	4814	4829	4843	4857	4871	4886	4900	1	3	4	6	7
31	4914	4928	4942	4955	4969	4983	4997	5011	5024	5038	1	3	4	6	7
32	5051	5065	5079	5092	5105	5119	5132	5145	5159	5172	1	3	4	5	7
33	5185	5198	5211	5224	5237	5250	5263	5276	5289	5302	1	3	4	5	6
34	5315	5328	5340	5353	5366	5378	5391	5403	5416	5428	1	3	4	5	6
35	5441	5453	5465	5478	5490	5502	5514	5527	5539	5551	1	2	4	5	6
36	5563	5575	5587	5599	5611	5623	5635	5647	5658	5670	1	2	4	5	6
37	5682	5694	5705	5717	5729	5740	5752	5763	5775	5786	1	2	3	5	6
38	5798	5809	5821	5832	5843	5855	5866	5877	5888	5899	1	2	3	5	6
39	5911	5922	5933	5944	5955	5966	5977	5988	5999	6010	1	2	3	4	5
40	6021	6031	6042	6053	6064	6075	6085	6096	6107	6117	1	2	3	4	5
41	6128	6138	6149	6160	6170	6180	6191	6201	6212	6222	1	2	3	4	5
42	6232	6243	6253	6263	6274	6284	6294	6304	6314	6325	1	2	3	4	5
43	6335	6345	6355	6365	6375	6385	6395	6405	6415	6425	1	2	3	4	5
44	6435	6444	6454	6464	6474	6484	6493	6503	6513	6522	1	2	3	4	5
45	6532	6542	6551	6561	6571	6580	6590	6599	6609	6618	1	2	3	4	5
46	6628	6637	6646	6656	6665	6675	6684	6693	6702	6712	1	2	3	4	5
47	6721	6730	6739	6749	6758	6767	6776	6785	6794	6803	1	2	3	4	5
48	6812	6821	6830	6839	6848	6857	6866	6875	6884	6893	1	2	3	4	4
49	6902	6911	6920	6928	6937	6946	6955	6964	6972	6981	1	2	3	4	4
50	6990	6998	7007	7016	7024	7033	7042	7050	7059	7067	1	2	3	3	4
51	7076	7084	7093	7101	7110	7118	7126	7135	7143	7152	1	2	3	3	4
52	7160	7168	7177	7185	7193	7202	7210	7218	7226	7235	1	2	2	3	4
53	7243	7251	7259	7267	7275	7284	7292	7300	7308	7316	1	2	2	3	4
54	7324	7332	7340	7348	7356	7364	7372	7380	7388	7396	1	2	2	3	4
N	0	1	2	3	4	5	6	7	8	9	1	2	3	4	5

FOUR-PLACE LOGARITHMS (Continued)

N	0	1	2	3	4	5	6	7	8	9	Proportional Parts 1 2 3 4 5
55	7404	7412	7419	7427	7435	7443	7451	7459	7466	7474	1 2 2 3 4
56	7482	7490	7497	7505	7513	7520	7528	7536	7543	7551	1 2 2 3 4
57	7559	7566	7574	7582	7589	7597	7604	7612	7619	7627	1 2 2 3 4
58	7634	7642	7649	7657	7664	7672	7679	7686	7694	7701	1 1 2 3 4
59	7709	7716	7723	7731	7738	7745	7752	7760	7767	7774	1 1 2 3 4
60	7782	7789	7796	7803	7810	7818	7825	7832	7839	7846	1 1 2 3 4
61	7853	7860	7868	7875	7882	7889	7896	7903	7910	7917	1 1 2 3 4
62	7924	7931	7938	7945	7952	7959	7966	7973	7980	7987	1 1 2 3 3
63	7993	8000	8007	8014	8021	8028	8035	8041	8048	8055	1 1 2 3 3
64	8062	8069	8075	8082	8089	8096	8102	8109	8116	8122	1 1 2 3 3
65	8129	8136	8142	8149	8156	8162	8169	8176	8182	8189	1 1 2 3 3
66	8195	8202	8209	8215	8222	8228	8235	8241	8248	8254	1 1 2 3 3
67	8261	8267	8274	8280	8287	8293	8299	8306	8312	8319	1 1 2 3 3
68	8325	8331	8338	8344	8351	8357	8363	8370	8376	8382	1 1 2 3 3
69	8388	8395	8401	8407	8414	8420	8426	8432	8439	8445	1 1 2 2 3
70	8451	8457	8463	8470	8476	8482	8488	8494	8500	8506	1 1 2 2 3
71	8513	8519	8525	8531	8537	8543	8549	8555	8561	8567	1 1 2 2 3
72	8573	8579	8585	8591	8597	8603	8609	8615	8621	8627	1 1 2 2 3
73	8633	8639	8645	8651	8657	8663	8669	8675	8681	8686	1 1 2 2 3
74	8692	8698	8704	8710	8716	8722	8727	8733	8739	8745	1 1 2 2 3
75	8751	8756	8762	8768	8774	8779	8785	8791	8797	8802	1 1 2 2 3
76	8808	8814	8820	8825	8831	8837	8842	8848	8854	8859	1 1 2 2 3
77	8865	8871	8876	8882	8887	8893	8899	8904	8910	8915	1 1 2 2 3
78	8921	8927	8932	8938	8943	8949	8954	8960	8965	8971	1 1 2 2 3
79	8976	8982	8987	8993	8998	9004	9009	9015	9020	9025	1 1 2 2 3
80	9031	9036	9042	9047	9053	9058	9063	9069	9074	9079	1 1 2 2 3
81	9085	9090	9096	9101	9106	9112	9117	9122	9128	9133	1 1 2 2 3
82	9138	9143	9149	9154	9159	9165	9170	9175	9180	9186	1 1 2 2 3
83	9191	9196	9201	9206	9212	9217	9222	9227	9232	9238	1 1 2 2 3
84	9243	9248	9253	9258	9263	9269	9274	9279	9284	9289	1 1 2 2 3
85	9294	9299	9304	9309	9315	9320	9325	9330	9335	9340	1 1 2 2 3
86	9345	9350	9355	9360	9365	9370	9375	9380	9385	9390	1 1 2 2 3
87	9395	9400	9405	9410	9415	9420	9425	9430	9435	9440	0 1 1 2 2
88	9445	9450	9455	9460	9465	9469	9474	9479	9484	9489	0 1 1 2 2
89	9494	9499	9504	9509	9513	9518	9523	9528	9533	9538	0 1 1 2 2
90	9542	9547	9552	9557	9562	9566	9571	9576	9581	9586	0 1 1 2 2
91	9590	9595	9600	9605	9609	9614	9619	9624	9628	9633	0 1 1 2 2
92	9638	9643	9647	9652	9657	9661	9666	9671	9675	9680	0 1 1 2 2
93	9685	9689	9694	9699	9703	9708	9713	9717	9722	9727	0 1 1 2 2
94	9731	9736	9741	9745	9750	9754	9759	9763	9768	9773	0 1 1 2 2
95	9777	9782	9786	9791	9795	9800	9805	9809	9814	9818	0 1 1 2 2
96	9823	9827	9832	9836	9841	9845	9850	9854	9859	9863	0 1 1 2 2
97	9868	9872	9877	9881	9886	9890	9894	9899	9903	9908	0 1 1 2 2
98	9912	9917	9921	9926	9930	9934	9939	9943	9948	9952	0 1 1 2 2
99	9956	9961	9965	9969	9974	9978	9983	9987	9991	9996	0 1 1 2 2
N	0	1	2	3	4	5	6	7	8	9	1 2 3 4 5

FOUR-PLACE ANTILOGARITHMS

	0	1	2	3	4	5	6	7	8	9	Proportional Parts 2	3	4	5	1
.00	1000	1002	1005	1007	1009	1012	1014	1016	1019	1021	0	0	1	1	1
.01	1023	1026	1028	1030	1033	1035	1038	1040	1042	1045	0	0	1	1	1
.02	1047	1050	1052	1054	1057	1059	1062	1064	1067	1069	0	0	1	1	1
.03	1072	1074	1076	1079	1081	1084	1086	1089	1091	1094	0	0	1	1	1
.04	1096	1099	1102	1104	1107	1109	1112	1114	1117	1119	0	1	1	1	1
.05	1122	1125	1127	1130	1132	1135	1138	1140	1143	1146	0	1	1	1	1
.06	1148	1151	1153	1156	1159	1161	1164	1167	1169	1172	0	1	1	1	1
.07	1175	1178	1180	1183	1186	1189	1191	1194	1197	1199	0	1	1	1	1
.08	1202	1205	1208	1211	1213	1216	1219	1222	1225	1227	0	1	1	1	1
.09	1230	1233	1236	1239	1242	1245	1247	1250	1253	1256	0	1	1	1	1
.10	1259	1262	1265	1268	1271	1274	1276	1279	1282	1285	0	1	1	1	1
.11	1288	1291	1294	1297	1300	1303	1306	1309	1312	1315	0	1	1	1	2
.12	1318	1321	1324	1327	1330	1334	1337	1340	1343	1346	0	1	1	1	2
.13	1349	1352	1355	1358	1361	1365	1368	1371	1374	1377	0	1	1	1	2
.14	1380	1384	1387	1390	1393	1396	1400	1403	1406	1409	0	1	1	1	2
.15	1413	1416	1419	1422	1426	1429	1432	1435	1439	1442	0	1	1	1	2
.16	1445	1449	1452	1455	1459	1462	1466	1469	1472	1476	0	1	1	1	2
.17	1479	1483	1486	1489	1493	1496	1500	1503	1507	1510	0	1	1	1	2
.18	1514	1517	1521	1524	1528	1531	1535	1538	1542	1545	0	1	1	1	2
.19	1549	1552	1556	1560	1563	1567	1570	1574	1578	1581	0	1	1	1	2
.20	1585	1589	1592	1596	1600	1603	1607	1611	1614	1618	0	1	1	1	2
.21	1622	1626	1629	1633	1637	1641	1644	1648	1652	1656	0	1	1	1	2
.22	1660	1663	1667	1671	1675	1679	1683	1687	1690	1694	0	1	1	2	2
.23	1698	1702	1706	1710	1714	1718	1722	1726	1730	1734	0	1	1	2	2
.24	1738	1742	1746	1750	1754	1758	1762	1766	1770	1774	0	1	1	2	2
.25	1778	1782	1786	1791	1795	1799	1803	1807	1811	1816	0	1	1	2	2
.26	1820	1824	1828	1832	1837	1841	1845	1849	1854	1858	0	1	1	2	2
.27	1862	1866	1871	1875	1879	1884	1888	1892	1897	1901	0	1	1	2	2
.28	1905	1910	1914	1919	1923	1928	1932	1936	1941	1945	0	1	1	2	2
.29	1950	1954	1959	1963	1968	1972	1977	1982	1986	1991	0	1	1	2	2
.30	1995	2000	2004	2009	2014	2018	2023	2028	2032	2037	0	1	1	2	2
.31	2042	2046	2051	2056	2061	2065	2070	2075	2080	2084	0	1	1	2	2
.32	2089	2094	2099	2104	2109	2113	2118	2123	2128	2133	0	1	1	2	2
.33	2138	2143	2148	2153	2158	2163	2168	2173	2178	2183	0	1	1	2	2
.34	2188	2193	2198	2203	2208	2213	2218	2223	2228	2234	1	1	2	2	3
.35	2239	2244	2249	2254	2259	2265	2270	2275	2280	2286	1	1	2	2	3
.36	2291	2296	2301	2307	2312	2317	2323	2328	2333	2339	1	1	2	2	3
.37	2344	2350	2355	2360	2366	2371	2377	2382	2388	2393	1	1	2	2	3
.38	2399	2404	2410	2415	2421	2427	2432	2438	2443	2449	1	1	2	2	3
.39	2455	2460	2466	2472	2477	2483	2489	2495	2500	2506	1	1	2	2	3
.40	2512	2518	2523	2529	2535	2541	2547	2553	2559	2564	1	1	2	2	3
.41	2570	2576	2582	2588	2594	2600	2606	2612	2618	2624	1	1	2	2	3
.42	2630	2636	2642	2649	2655	2661	2667	2673	2679	2685	1	1	2	2	3
.43	2692	2698	2704	2710	2716	2723	2729	2735	2742	2748	1	1	2	2	3
.44	2754	2761	2767	2773	2780	2786	2793	2799	2805	2812	1	1	2	3	3
.45	2818	2825	2831	2838	2844	2851	2858	2864	2871	2877	1	1	2	3	3
.46	2884	2891	2897	2904	2911	2917	2924	2931	2938	2944	1	1	2	3	3
.47	2951	2958	2965	2972	2979	2985	2992	2999	3006	3013	1	1	2	3	3
.48	3020	3027	3034	3041	3048	3055	3062	3069	3076	3083	1	1	2	3	3
.49	3090	3097	3105	3112	3119	3126	3133	3141	3148	3155	1	1	2	3	4

	0	1	2	3	4	5	6	7	8	9	1	2	3	4	5

FOUR-PLACE ANTILOGARITHMS (Continued)

	0	1	2	3	4	5	6	7	8	9	Proportional Parts 1	2	3	4	5
.50	3162	3170	3177	3184	3192	3199	3206	3214	3221	3228	1	1	2	3	4
.51	3236	3243	3251	3258	3266	3273	3281	3289	3296	3304	1	1	2	3	4
.52	3311	3319	3327	3334	3342	3350	3357	3365	3373	3381	1	1	2	3	4
.53	3388	3396	3404	3412	3420	3428	3436	3443	3451	3459	1	2	2	3	4
.54	3467	3475	3483	3491	3499	3508	3516	3524	3532	3540	1	2	2	3	4
.55	3548	3556	3565	3573	3581	3589	3597	3606	3614	3622	1	2	2	3	4
.56	3631	3639	3648	3656	3664	3673	3681	3690	3698	3707	1	2	2	3	4
.57	3715	3724	3733	3741	3750	3758	3767	3776	3784	3793	1	2	3	3	4
.58	3802	3811	3819	3828	3837	3846	3855	3864	3873	3882	1	2	3	3	4
.59	3890	3899	3908	3917	3926	3936	3945	3954	3963	3972	1	2	3	4	5
.60	3981	3990	3999	4009	4018	4027	4036	4046	4055	4064	1	2	3	4	5
.61	4074	4083	4093	4102	4111	4121	4130	4140	4150	4159	1	2	3	4	5
.62	4169	4178	4188	4198	4207	4217	4227	4236	4246	4256	1	2	3	4	5
.63	4266	4276	4285	4295	4305	4315	4325	4335	4345	4355	1	2	3	4	5
.64	4365	4375	4385	4395	4406	4416	4426	4436	4446	4457	1	2	3	4	5
.65	4467	4477	4487	4498	4508	4519	4529	4539	4550	4560	1	2	3	4	5
.66	4571	4581	4592	4603	4613	4624	4634	4645	4656	4667	1	2	3	4	5
.67	4677	4688	4699	4710	4721	4732	4742	4753	4764	4775	1	2	3	4	5
.68	4786	4797	4808	4819	4831	4842	4853	4864	4875	4887	1	2	3	5	6
.69	4898	4909	4920	4932	4943	4955	4966	4977	4989	5000	1	2	3	5	6
.70	5012	5023	5035	5047	5058	5070	5082	5093	5105	5117	1	2	3	5	6
.71	5129	5140	5152	5164	5176	5188	5200	5212	5224	5236	1	2	4	5	6
.72	5248	5260	5272	5284	5297	5309	5321	5333	5346	5358	1	2	4	5	6
.73	5370	5383	5395	5408	5420	5433	5445	5458	5470	5483	1	3	4	5	6
.74	5495	5508	5521	5534	5546	5559	5572	5585	5598	5610	1	3	4	5	6
.75	5623	5636	5649	5662	5675	5689	5702	5715	5728	5741	1	3	4	5	7
.76	5754	5768	5781	5794	5808	5821	5834	5848	5861	5875	1	3	4	5	7
.77	5888	5902	5916	5929	5943	5957	5970	5984	5998	6012	1	3	4	5	7
.78	6026	6039	6053	6067	6081	6095	6109	6124	6138	6152	1	3	4	6	7
.79	6166	6180	6194	6209	6223	6237	6252	6266	6281	6295	1	3	4	6	7
.80	6310	6324	6339	6353	6368	6383	6397	6412	6427	6442	1	3	4	6	7
.81	6457	6471	6486	6501	6516	6531	6546	6561	6577	6592	2	3	5	6	8
.82	6607	6622	6637	6653	6668	6683	6699	6714	6730	6745	2	3	5	6	8
.83	6761	6776	6792	6808	6823	6839	6855	6871	6887	6902	2	3	5	6	8
.84	6918	6934	6950	6966	6982	6998	7015	7031	7047	7063	2	3	5	7	8
.85	7079	7096	7112	7129	7145	7161	7178	7194	7211	7228	2	3	5	7	8
.86	7244	7261	7278	7295	7311	7328	7345	7362	7379	7396	2	3	5	7	8
.87	7413	7430	7447	7464	7482	7499	7516	7534	7551	7568	2	4	5	7	9
.88	7586	7603	7621	7638	7656	7674	7691	7709	7727	7745	2	4	5	7	9
.89	7762	7780	7798	7816	7834	7852	7870	7889	7907	7925	2	4	6	7	9
.90	7943	7962	7980	7998	8017	8035	8054	8072	8091	8110	2	4	6	7	9
.91	8128	8147	8166	8185	8204	8222	8241	8260	8279	8299	2	4	6	8	9
.92	8318	8337	8356	8375	8395	8414	8433	8453	8472	8492	2	4	6	8	10
.93	8511	8531	8551	8570	8590	8610	8630	8650	8670	8690	2	4	6	8	10
.94	8710	8730	8750	8770	8790	8810	8831	8851	8872	8892	2	4	6	8	10
.95	8913	8933	8954	8974	8995	9016	9036	9057	9078	9099	2	4	6	8	10
.96	9120	9141	9162	9183	9204	9226	9247	9268	9290	9311	2	4	6	9	11
.97	9333	9354	9376	9397	9419	9441	9462	9484	9506	9528	2	4	6	9	11
.98	9550	9572	9594	9616	9638	9661	9683	9705	9727	9750	2	4	7	9	11
.99	9772	9795	9817	9840	9863	9886	9908	9931	9954	9977	2	5	7	9	11

	0	1	2	3	4	5	6	7	8	9	1	2	3	4	5

FIVE-PLACE LOGARITHMS

N.	0	1	2	3	4	5	6	7	8	9	Proportional parts		
100	00 000	043	087	130	173	217	260	303	346	389	**44**	**43**	**42**
101	432	475	518	561	604	647	689	732	775	817	1 4,4	4,3	4,2
102	860	903	945	988	*030	*072	*115	*157	*199	*242	2 8,8	8,6	8,4
103	01 284	326	368	410	452	494	536	578	620	662	3 13,2	12,9	12,6
104	703	745	787	828	870	912	953	995	*036	*078	4 17,6	17,2	16,8
105	02 119	160	202	243	284	325	366	407	449	490	5 22,0	21,5	21,0
106	531	572	612	653	694	735	776	816	857	898	6 26,4	25,8	25,2
107	938	979	*019	*060	*100	*141	*181	*222	*262	*302	7 30,8	30,1	29,4
108	03 342	383	423	463	503	543	583	623	663	703	8 35,2	34,4	33,6
109	743	782	822	862	902	941	981	*021	*060	*100	9 39,6	38,7	37,8
110	04 139	179	218	258	297	336	376	415	454	493	**41**	**40**	**39**
111	532	571	610	650	689	727	766	805	844	883	1 4,1	4,0	3,9
112	922	961	999	*038	*077	*115	*154	*192	*231	*269	2 8,2	8,0	7,8
113	05 308	346	385	423	461	500	538	576	614	652	3 12,3	12,0	11,7
114	690	729	767	805	843	881	918	956	994	*032	4 16,4	16,0	15,6
115	06 070	108	145	183	221	258	296	333	371	408	5 20,5	20,0	19,5
116	446	483	521	558	595	633	670	707	744	781	6 24,6	24,0	23,4
117	819	856	893	930	967	*004	*041	*078	*115	*151	7 28,7	28,0	27,3
118	07 188	225	262	298	335	372	408	445	482	518	8 32,8	32,0	31,2
119	555	591	628	664	700	737	773	809	846	882	9 36,9	36,0	35,1
120	918	954	990	*027	*063	*099	*135	*171	*207	*243	**38**	**37**	**36**
121	08 279	314	350	386	422	458	493	529	565	600	1 3,8	3,7	3,6
122	636	672	707	743	778	814	849	884	920	955	2 7,6	7,4	7,2
123	991	*026	*061	*096	*132	*167	*202	*237	*272	*307	3 11,4	11,1	10,8
124	09 342	377	412	447	482	517	552	587	621	656	4 15,2	14,8	14,4
125	691	726	760	795	830	864	899	934	968	*003	5 19,0	18,5	18,0
126	10 037	072	106	140	175	209	243	278	312	346	6 22,8	22,2	21,6
127	380	415	449	483	517	551	585	619	653	687	7 26,6	25,9	25,2
128	721	755	789	823	857	890	924	958	992	*025	8 30,4	29,6	28,8
129	11 059	093	126	160	193	227	261	294	327	361	9 34,2	33,3	32,4
130	394	428	461	494	528	561	594	628	661	694	**35**	**34**	**33**
131	727	760	793	826	860	893	926	959	992	*024	1 3,5	3,4	3,3
132	12 057	090	123	156	189	222	254	287	320	352	2 7,0	6,8	6,6
133	385	418	450	483	516	548	581	613	646	678	3 10,5	10,2	9,9
134	710	743	775	808	840	872	905	937	969	*001	4 14,0	13,6	13,2
135	13 033	066	098	130	162	194	226	258	290	322	5 17,5	17,0	16,5
136	354	386	418	450	481	513	545	577	609	640	6 21,0	20,4	19,8
137	672	704	735	767	799	830	862	893	925	956	7 24,5	23,8	23,1
138	988	*019	*051	*082	*114	*145	*176	*208	*239	*270	8 28,0	27,2	26,4
139	14 301	333	364	395	426	457	489	520	551	582	9 31,5	30,6	29,7
140	613	644	675	706	737	768	799	829	860	891	**32**	**31**	**30**
141	922	953	983	*014	*045	*076	*106	*137	*168	*198	1 3,2	3,1	3,0
142	15 229	259	290	320	351	381	412	442	473	503	2 6,4	6,2	6,0
143	534	564	594	625	655	685	715	746	776	806	3 9,6	9,3	9,0
144	836	866	897	927	957	987	*017	*047	*077	*107	4 12,8	12,4	12,0
145	16 137	167	197	227	256	286	316	346	376	406	5 16,0	15,5	15,0
146	435	465	495	524	554	584	613	643	673	702	6 19,2	18,6	18,0
147	732	761	791	820	850	879	909	938	967	997	7 22,4	21,7	21,0
148	17 026	056	085	114	143	173	202	231	260	289	8 25,6	24,8	24,0
149	319	348	377	406	435	464	493	522	551	580	9 28,8	27,9	27,0
150	609	638	667	696	725	754	782	811	840	869			

N.	0	1	2	3	4	5	6	7	8	9	Proportional parts

FIVE-PLACE LOGARITHMS (Continued)

N.	0	1	2	3	4	5	6	7	8	9
150	17 609	638	667	696	725	754	782	811	840	869
151	898	926	955	984	*013	*041	*070	*099	*127	*156
152	18 184	213	241	270	298	327	355	384	412	441
153	469	498	526	554	583	611	639	667	696	724
154	752	780	808	837	865	893	921	949	977	*005
155	19 033	061	089	117	145	173	201	229	257	285
156	312	340	368	396	424	451	479	507	535	562
157	590	618	645	673	700	728	756	783	811	838
158	866	893	921	948	976	*003	*030	*058	*085	*112
159	20 140	167	194	222	249	276	303	330	358	385
160	412	439	466	493	520	548	575	602	629	656
161	683	710	737	763	790	817	844	871	898	925
162	952	978	*005	*032	*059	*085	*112	*139	*165	*192
163	21 219	245	272	299	325	352	378	405	431	458
164	484	511	537	564	590	617	643	669	696	722
165	748	775	801	827	854	880	906	932	958	985
166	22 011	037	063	089	115	141	167	194	220	246
167	272	298	324	350	376	401	427	453	479	505
168	531	557	583	608	634	660	686	712	737	763
169	789	814	840	866	891	917	943	968	994	*019
170	23 045	070	096	121	147	172	198	223	249	274
171	300	325	350	376	401	426	452	477	502	528
172	553	578	603	629	654	679	704	729	754	779
173	805	830	855	880	905	930	955	980	*005	*030
174	24 055	080	105	130	155	180	204	229	254	279
175	304	329	353	378	403	428	452	477	502	527
176	551	576	601	625	650	674	699	724	748	773
177	797	822	846	871	895	920	944	969	993	*018
178	25 042	066	091	115	139	164	188	212	237	261
179	285	310	334	358	382	406	431	455	479	503
180	527	551	575	600	624	648	672	696	720	744
181	768	792	816	840	864	888	912	935	959	983
182	26 007	031	055	079	102	126	150	174	198	221
183	245	269	293	316	340	364	387	411	435	458
184	482	505	529	553	576	600	623	647	670	694
185	717	741	764	788	811	834	858	881	905	928
186	951	975	998	*021	*045	*068	*091	*114	*138	*161
187	27 184	207	231	254	277	300	323	346	370	393
188	416	439	462	485	508	531	554	577	600	623
189	646	669	692	715	738	761	784	807	830	852
190	875	898	921	944	967	989	*012	*035	*058	*081
191	28 103	126	149	171	194	217	240	262	285	307
192	330	353	375	398	421	443	466	488	511	533
193	556	578	601	623	646	668	691	713	735	758
194	780	803	825	847	870	892	914	937	959	981
195	29 003	026	048	070	092	115	137	159	181	203
196	226	248	270	292	314	336	358	380	403	425
197	447	469	491	513	535	557	579	601	623	645
198	667	688	710	732	754	776	798	820	842	863
199	885	907	929	951	973	994	*016	*038	*060	*081
200	30 103	125	146	168	190	211	233	255	276	298

Proportional parts		
	29	**28**
1	2,9	2,8
2	5,8	5,6
3	8,7	8,4
4	11,6	11,2
5	14,5	14,0
6	17,4	16,8
7	20,3	19,6
8	23,2	22,4
9	26,1	25,2

Proportional parts		
	27	**26**
1	2,7	2,6
2	5,4	5,2
3	8,1	7,8
4	10,8	10,4
5	13,5	13,0
6	16,2	15,6
7	18,9	18,2
8	21,6	20,8
9	24,3	23,4

Proportional parts	
	25
1	2,5
2	5,0
3	7,5
4	10,0
5	12,5
6	15,0
7	17,5
8	20,0
9	22,5

Proportional parts		
	24	**23**
1	2,4	2,3
2	4,8	4,6
3	7,2	6,9
4	9,6	9,2
5	12,0	11,5
6	14,4	13,8
7	16,8	16,1
8	19,2	18,4
9	21,6	20,7

Proportional parts		
	22	**21**
1	2,2	2,1
2	4,4	4,2
3	6,6	6,3
4	8,8	8,4
5	11,0	10,5
6	13,2	12,6
7	15,4	14,7
8	17,6	16,8
9	19,8	18,9

N.	0	1	2	3	4	5	6	7	8	9	Proportional parts

FIVE-PLACE LOGARITHMS (Continued)

N.	0	1	2	3	4	5	6	7	8	9
200	30 103	125	146	168	190	211	233	255	276	298
201	320	341	363	384	406	428	449	471	492	514
202	535	557	578	600	621	643	664	685	707	728
203	750	771	792	814	835	856	878	899	920	942
204	963	984	*006	*027	*048	*069	*091	*112	*133	*154
205	31 175	197	218	239	260	281	302	323	345	366
206	387	408	429	450	471	492	513	534	555	576
207	597	618	639	660	681	702	723	744	765	785
208	806	827	848	869	890	911	931	952	973	994
209	32 015	035	056	077	098	118	139	160	181	201
210	222	243	263	284	305	325	346	366	387	408
211	428	449	469	490	510	531	552	572	593	613
212	634	654	675	695	715	736	756	777	797	818
213	838	858	879	899	919	940	960	980	*001	*021
214	33 041	062	082	102	122	143	163	183	203	224
215	244	264	284	304	325	345	365	385	405	425
216	445	465	486	506	526	546	566	586	606	626
217	646	666	686	706	726	746	766	786	806	826
218	846	866	885	905	925	945	965	985	*005	*025
219	34 044	064	084	104	124	143	163	183	203	223
220	242	262	282	301	321	341	361	380	400	420
221	439	459	479	498	518	537	557	577	596	616
222	635	655	674	694	713	733	753	772	792	811
223	830	850	869	889	908	928	947	967	986	*005
224	35 025	044	064	083	102	122	141	160	180	199
225	218	238	257	276	295	315	334	353	372	392
226	411	430	449	468	488	507	526	545	564	583
227	603	622	641	660	679	698	717	736	755	774
228	793	813	832	851	870	889	908	927	946	965
229	984	*003	*021	*040	*059	*078	*097	*116	*135	*154
230	36 173	192	211	229	248	267	286	305	324	342
231	361	380	399	418	436	455	474	493	511	530
232	549	568	586	605	624	642	661	680	698	717
233	736	754	773	791	810	829	847	866	884	903
234	922	940	959	977	996	*014	*033	*051	*070	*088
235	37 107	125	144	162	181	199	218	236	254	273
236	291	310	328	346	365	383	401	420	438	457
237	475	493	511	530	548	566	585	603	621	639
238	658	676	694	712	731	749	767	785	803	822
239	840	858	876	894	912	931	949	967	985	*003
240	38 021	039	057	075	093	112	130	148	166	184
241	202	220	238	256	274	292	310	328	346	364
242	382	399	417	435	453	471	489	507	525	543
243	561	578	596	614	632	650	668	686	703	721
244	739	757	775	792	810	828	846	863	881	899
245	917	934	952	970	987	*005	*023	*041	*058	*076
246	39 094	111	129	146	164	182	199	217	235	252
247	270	287	305	322	340	358	375	393	410	428
248	445	463	480	498	515	533	550	568	585	602
249	620	637	655	672	690	707	724	742	759	777
250	794	811	829	846	863	881	898	915	933	950

Proportional parts		
	22	**21**
1	2,2	2,1
2	4,4	4,2
3	6,6	6,3
4	8,8	8,4
5	11,0	10,5
6	13,2	12,6
7	15,4	14,7
8	17,6	16,8
9	19,8	18,9

Proportional parts	
	20
1	2,0
2	4,0
3	6,0
4	8,0
5	10,0
6	12,0
7	14,0
8	16,0
9	18,0

Proportional parts	
	19
1	1,9
2	3,8
3	5,7
4	7,6
5	9,5
6	11,4
7	13,3
8	15,2
9	17,1

Proportional parts	
	18
1	1,8
2	3,6
3	5,4
4	7,2
5	9,0
6	10,8
7	12,6
8	14,4
9	16,2

Proportional parts	
	17
1	1,7
2	3,4
3	5,1
4	6,8
5	8,5
6	10,2
7	11,9
8	13,6
9	15,3

N.	0	1	2	3	4	5	6	7	8	9	Proportional parts

FIVE-PLACE LOGARITHMS (Continued)

N.	0	1	2	3	4	5	6	7	8	9	Proportional parts
250	39 794	811	829	846	863	881	898	915	933	950	**18**
251	967	985	*002	*019	*037	*054	*071	*088	*106	*123	1 | 1,8
252	40 140	157	175	192	209	226	243	261	278	295	2 | 3,6
253	312	329	346	364	381	398	415	432	449	466	3 | 5,4
254	483	500	518	535	552	569	586	603	620	637	4 | 7,2
255	654	671	688	705	722	739	756	773	790	807	5 | 9,0
256	824	841	858	875	892	909	926	943	960	976	6 | 10,8
257	993	*010	*027	*044	*061	*078	*095	*111	*128	*145	7 | 12,6
258	41 162	179	196	212	229	246	263	280	296	313	8 | 14,4
259	330	347	363	380	397	414	430	447	464	481	9 | 16,2
260	497	514	531	547	564	581	597	614	631	647	**17**
261	664	681	697	714	731	747	764	780	797	814	1 | 1,7
262	830	847	863	880	896	913	929	946	963	979	2 | 3,4
263	996	*012	*029	*045	*062	*078	*095	*111	*127	*144	3 | 5,1
264	42 160	177	193	210	226	243	259	275	292	308	4 | 6,8
265	325	341	357	374	390	406	423	439	455	472	5 | 8,5
266	488	504	521	537	553	570	586	602	619	635	6 | 10,2
267	651	667	684	700	716	732	749	765	781	797	7 | 11,9
268	813	830	846	862	878	894	911	927	943	959	8 | 13,6
269	975	991	*008	*024	*040	*056	*072	*088	*104	*120	9 | 15,3
270	43 136	152	169	185	201	217	233	249	265	281	**16**
271	297	313	329	345	361	377	393	409	425	441	1 | 1,6
272	457	473	489	505	521	537	553	569	584	600	2 | 3,2
273	616	632	648	664	680	696	712	727	743	759	3 | 4,8
274	775	791	807	823	838	854	870	886	902	917	4 | 6,4
275	933	949	965	981	996	*012	*028	*044	*059	*075	5 | 8,0
276	44 091	107	122	138	154	170	185	201	217	232	6 | 9,6
277	248	264	279	295	311	326	342	358	373	389	7 | 11,2
278	404	420	436	451	467	483	498	514	529	545	8 | 12,8
279	560	576	592	607	623	638	654	669	685	700	9 | 14,4
280	716	731	747	762	778	793	809	824	840	855	**15**
281	871	886	902	917	932	948	963	979	994	*010	1 | 1,5
282	45 025	040	056	071	086	102	117	133	148	163	2 | 3,0
283	179	194	209	225	240	255	271	286	301	317	3 | 4,5
284	332	347	362	378	393	408	423	439	454	469	4 | 6,0
285	484	500	515	530	545	561	576	591	606	621	5 | 7,5
286	637	652	667	682	697	712	728	743	758	773	6 | 9,0
287	788	803	818	834	849	864	879	894	909	924	7 | 10,5
288	939	954	969	984	*000	*015	*030	*045	*060	*075	8 | 12,0
289	46 090	105	120	135	150	165	180	195	210	225	9 | 13,5
290	240	255	270	285	300	315	330	345	359	374	**14**
291	389	404	419	434	449	464	479	494	509	523	1 | 1,4
292	538	553	568	583	598	613	627	642	657	672	2 | 2,8
293	687	702	716	731	746	761	776	790	805	820	3 | 4,2
294	835	850	864	879	894	909	923	938	953	967	4 | 5,6
295	982	997	*012	*026	*041	*056	*070	*085	*100	*114	5 | 7,0
296	47 129	144	159	173	188	202	217	232	246	261	6 | 8,4
297	276	290	305	319	334	349	363	378	392	407	7 | 9,8
298	422	436	451	465	480	494	509	524	538	553	8 | 11,2
299	567	582	596	611	625	640	654	669	683	698	9 | 12,6
300	712	727	741	756	770	784	799	813	828	842	

N.	0	1	2	3	4	5	6	7	8	9	Proportional parts

FIVE-PLACE LOGARITHMS (Continued)

N.	0	1	2	3	4	5	6	7	8	9
300	47 712	727	741	756	770	784	799	813	828	842
301	857	871	885	900	914	929	943	958	972	986
302	48 001	015	029	044	058	073	087	101	116	130
303	144	159	173	187	202	216	230	244	259	273
304	287	302	316	330	344	359	373	387	401	416
305	430	444	458	473	487	501	515	530	544	558
306	572	586	601	615	629	643	657	671	686	700
307	714	728	742	756	770	785	799	813	827	841
308	855	869	883	897	911	926	940	954	968	982
309	996	*010	*024	*038	*052	*066	*080	*094	*108	*122
310	49 136	150	164	178	192	206	220	234	248	262
311	276	290	304	318	332	346	360	374	388	402
312	415	429	443	457	471	485	499	513	527	541
313	554	568	582	596	610	624	638	651	665	679
314	693	707	721	734	748	762	776	790	803	817
315	831	845	859	872	886	900	914	927	941	955
316	969	982	996	*010	*024	*037	*051	*065	*079	*092
317	50 106	120	133	147	161	174	188	202	215	229
318	243	256	270	284	297	311	325	338	352	365
319	379	393	406	420	433	447	461	474	488	501
320	515	529	542	556	569	583	596	610	623	637
321	651	664	678	691	705	718	732	745	759	772
322	786	799	813	826	840	853	866	880	893	907
323	920	934	947	961	974	987	*001	*014	*028	*041
324	51 055	068	081	095	108	121	135	148	162	175
325	188	202	215	228	242	255	268	282	295	308
326	322	335	348	362	375	388	402	415	428	441
327	455	468	481	495	508	521	534	548	561	574
328	587	601	614	627	640	654	667	680	693	706
329	720	733	746	759	772	786	799	812	825	838
330	851	865	878	891	904	917	930	943	957	970
331	983	996	*009	*022	*035	*048	*061	*075	*088	*101
332	52 114	127	140	153	166	179	192	205	218	231
333	244	257	270	284	297	310	323	336	349	362
334	375	388	401	414	427	440	453	466	479	492
335	504	517	530	543	556	569	582	595	608	621
336	634	647	660	673	686	699	711	724	737	750
337	763	776	789	802	815	827	840	853	866	879
338	892	905	917	930	943	956	969	982	994	*007
339	53 020	033	046	058	071	084	097	110	122	135
340	148	161	173	186	199	212	224	237	250	263
341	275	288	301	314	326	339	352	364	377	390
342	403	415	428	441	453	466	479	491	504	517
343	529	542	555	567	580	593	605	618	631	643
344	656	668	681	694	706	719	732	744	757	769
345	782	794	807	820	832	845	857	870	882	895
346	908	920	933	945	958	970	983	995	*008	*020
347	54 033	045	058	070	083	095	108	120	133	145
348	158	170	183	195	208	220	233	245	258	270
349	283	295	307	320	332	345	357	370	382	394
350	407	419	432	444	456	469	481	494	506	518

Proportional parts	
15	
1	1,5
2	3,0
3	4,5
4	6,0
5	7,5
6	9,0
7	10,5
8	12,0
9	13,5
14	
1	1,4
2	2,8
3	4,2
4	5,6
5	7,0
6	8,4
7	9,8
8	11,2
9	12,6
13	
1	1,3
2	2,6
3	3,9
4	5,2
5	6,5
6	7,8
7	9,1
8	10,4
9	11,7
12	
1	1,2
2	2,4
3	3,6
4	4,8
5	6,0
6	7,2
7	8,4
8	9,6
9	10,8

N.	0	1	2	3	4	5	6	7	8	9	Proportional parts

FIVE-PLACE LOGARITHMS (Continued)

N.	0	1	2	3	4	5	6	7	8	9
350	54 407	419	432	444	456	469	481	494	506	518
351	531	543	555	568	580	593	605	617	630	642
352	654	667	679	691	704	716	728	741	753	765
353	777	790	802	814	827	839	851	864	876	888
354	900	913	925	937	949	962	974	986	998	*011
355	55 023	035	047	060	072	084	096	108	121	133
356	145	157	169	182	194	206	218	230	242	255
357	267	279	291	303	315	328	340	352	364	376
358	388	400	413	425	437	449	461	473	485	497
359	509	522	534	546	558	570	582	594	606	618
360	630	642	654	666	678	691	703	715	727	739
361	751	763	775	787	799	811	823	835	847	859
362	871	883	895	907	919	931	943	955	967	979
363	991	*003	*015	*027	*038	*050	*062	*074	*086	*098
364	56 110	122	134	146	158	170	182	194	205	217
365	229	241	253	265	277	289	301	312	324	336
366	348	360	372	384	396	407	419	431	443	455
367	467	478	490	502	514	526	538	549	561	573
368	585	597	608	620	632	644	656	667	679	691
369	703	714	726	738	750	761	773	785	797	808
370	820	832	844	855	867	879	891	902	914	926
371	937	949	961	972	984	996	*008	*019	*031	*043
372	57 054	066	078	089	101	113	124	136	148	159
373	171	183	194	206	217	229	241	252	264	276
374	287	299	310	322	334	345	357	368	380	392
375	403	415	426	438	449	461	473	484	496	507
376	519	530	542	553	565	576	588	600	611	623
377	634	646	657	669	680	692	703	715	726	738
378	749	761	772	784	795	807	818	830	841	852
379	864	875	887	898	910	921	933	944	955	967
380	978	990	*001	*013	*024	*035	*047	*058	*070	*081
381	58 092	104	115	127	138	149	161	172	184	195
382	206	218	229	240	252	263	274	286	297	309
383	320	331	343	354	365	377	388	399	410	422
384	433	444	456	467	478	490	501	512	524	535
385	546	557	569	580	591	602	614	625	636	647
386	659	670	681	692	704	715	726	737	749	760
387	771	782	794	805	816	827	838	850	861	872
388	883	894	906	917	928	939	950	961	973	984
389	995	*006	*017	*028	*040	*051	*062	*073	*084	*095
390	59 106	118	129	140	151	162	173	184	195	207
391	218	229	240	251	262	273	284	295	306	318
392	329	340	351	362	373	384	395	406	417	428
393	439	450	461	472	483	494	506	517	528	539
394	550	561	572	583	594	605	616	627	638	649
395	660	671	682	693	704	715	726	737	748	759
396	770	780	791	802	813	824	835	846	857	868
397	879	890	901	912	923	934	945	956	966	977
398	988	999	*010	*021	*032	*043	*054	*065	*076	*086
399	60 097	108	119	130	141	152	163	173	184	195
400	206	217	228	239	249	260	271	282	293	304

Proportional parts	
	13
1	1,3
2	2,6
3	3,9
4	5,2
5	6,5
6	7,8
7	9,1
8	10,4
9	11,7
	12
1	1,2
2	2,4
3	3,6
4	4,8
5	6,0
6	7,2
7	8,4
8	9,6
9	10,8
	11
1	1,1
2	2,2
3	3,3
4	4,4
5	5,5
6	6,6
7	7,7
8	8,8
9	9,9
	10
1	1,0
2	2,0
3	3,0
4	4,0
5	5,0
6	6,0
7	7,0
8	8,0
9	9,0

N. 0 1 2 3 4 5 6 7 8 9 Proportional parts

FIVE-PLACE LOGARITHMS (Continued)

N.	0	1	2	3	4	5	6	7	8	9	Proportional parts
400	60 206	217	228	239	249	260	271	282	293	304	
401	314	325	336	347	358	369	379	390	401	412	
402	423	433	444	455	466	477	487	498	509	520	
403	531	541	552	563	574	584	595	606	617	627	
404	638	649	660	670	681	692	703	713	724	735	
405	746	756	767	778	788	799	810	821	831	842	
406	853	863	874	885	895	906	917	927	938	949	
407	959	970	981	991	*002	*013	*023	*034	*045	*055	**11**
408	61 066	077	087	098	109	119	130	140	151	162	1 | 1,1
409	172	183	194	204	215	225	236	247	257	268	2 | 2,2
											3 | 3,3
410	278	289	300	310	321	331	342	352	363	374	4 | 4,4
411	384	395	405	416	426	437	448	458	469	479	5 | 5,5
412	490	500	511	521	532	542	553	563	574	584	6 | 6,6
413	595	606	616	627	637	648	658	669	679	690	7 | 7,7
414	700	711	721	731	742	752	763	773	784	794	8 | 8,8
415	805	815	826	836	847	857	868	878	888	899	9 | 9,9
416	909	920	930	941	951	962	972	982	993	*003	
417	62 014	024	034	045	055	066	076	086	097	107	
418	118	128	138	149	159	170	180	190	201	211	
419	221	232	242	252	263	273	284	294	304	315	
420	325	335	346	356	366	377	387	397	408	418	**10**
421	428	439	449	459	469	480	490	500	511	521	1 | 1,0
422	531	542	552	562	572	583	593	603	613	624	2 | 2,0
423	634	644	655	665	675	685	696	706	716	726	3 | 3,0
424	737	747	757	767	778	788	798	808	818	829	4 | 4,0
425	839	849	859	870	880	890	900	910	921	931	5 | 5,0
426	941	951	961	972	982	992	*002	*012	*022	*033	6 | 6,0
427	63 043	053	063	073	083	094	104	114	124	134	7 | 7,0
428	144	155	165	175	185	195	205	215	225	236	8 | 8,0
429	246	256	266	276	286	296	306	317	327	337	9 | 9,0
430	347	357	367	377	387	397	407	417	428	438	
431	448	458	468	478	488	498	508	518	528	538	
432	548	558	568	579	589	599	609	619	629	639	
433	649	659	669	679	689	699	709	719	729	739	
434	749	759	769	779	789	799	809	819	829	839	
435	849	859	869	879	889	899	909	919	929	939	**9**
436	949	959	969	979	988	998	*008	*018	*028	*038	1 | 0,9
437	64 048	058	068	078	088	098	108	118	128	137	2 | 1,8
438	147	157	167	177	187	197	207	217	227	237	3 | 2,7
439	246	256	266	276	286	296	306	316	326	335	4 | 3,6
											5 | 4,5
440	345	355	365	375	385	395	404	414	424	434	6 | 5,4
441	444	454	464	473	483	493	503	513	523	532	7 | 6,3
442	542	552	562	572	582	591	601	611	621	631	8 | 7,2
443	640	650	660	670	680	689	699	709	719	729	9 | 8,1
444	738	748	758	768	777	787	797	807	816	826	
445	836	846	856	865	875	885	895	904	914	924	
446	933	943	953	963	972	982	992	*002	*011	*021	
447	65 031	040	050	060	070	079	089	099	108	118	
448	128	137	147	157	167	176	186	196	205	215	
449	225	234	244	254	263	273	283	292	302	312	
450	321	331	341	350	360	369	379	389	398	408	

N.	0	1	2	3	4	5	6	7	8	9	Proportional parts

FIVE-PLACE LOGARITHMS (Continued)

N.	0	1	2	3	4	5	6	7	8	9
450	65 321	331	341	350	360	369	379	389	398	408
451	418	427	437	447	456	466	475	485	495	504
452	514	523	533	543	552	562	571	581	591	600
453	610	619	629	639	648	658	667	677	686	696
454	706	715	725	734	744	753	763	772	782	792
455	801	811	820	830	839	849	858	868	877	887
456	896	906	916	925	935	944	954	963	973	982
457	992	*001	*011	*020	*030	*039	*049	*058	*068	*077
458	66 087	096	106	115	124	134	143	153	162	172
459	181	191	200	210	219	229	238	247	257	266
460	276	285	295	304	314	323	332	342	351	361
461	370	380	389	398	408	417	427	436	445	455
462	464	474	483	492	502	511	521	530	539	549
463	558	567	577	586	596	605	614	624	633	642
464	652	661	671	680	689	699	708	717	727	736
465	745	755	764	773	783	792	801	811	820	829
466	839	848	857	867	876	885	894	904	913	922
467	932	941	950	960	969	978	987	997	*006	*015
468	67 025	034	043	052	062	071	080	089	099	108
469	117	127	136	145	154	164	173	182	191	201
470	210	219	228	237	247	256	265	274	284	293
471	302	311	321	330	339	348	357	367	376	385
472	394	403	413	422	431	440	449	459	468	477
473	486	495	504	514	523	532	541	550	560	569
474	578	587	596	605	614	624	633	642	651	660
475	669	679	688	697	706	715	724	733	742	752
476	761	770	779	788	797	806	815	825	834	843
477	852	861	870	879	888	897	906	916	925	934
478	943	952	961	970	979	988	997	*006	*015	*024
479	68 034	043	052	061	070	079	088	097	106	115
480	124	133	142	151	160	169	178	187	196	205
481	215	224	233	242	251	260	269	278	287	296
482	305	314	323	332	341	350	359	368	377	386
483	395	404	413	422	431	440	449	458	467	476
484	485	494	502	511	520	529	538	547	556	565
485	574	583	592	601	610	619	628	637	646	655
486	664	673	681	690	699	708	717	726	735	744
487	753	762	771	780	789	797	806	815	824	833
488	842	851	860	869	878	886	895	904	913	922
489	931	940	949	958	966	975	984	993	*002	*011
490	69 020	028	037	046	055	064	073	082	090	099
491	108	117	126	135	144	152	161	170	179	188
492	197	205	214	223	232	241	249	258	267	276
493	285	294	302	311	320	329	338	346	355	364
494	373	381	390	399	408	417	425	434	443	452
495	461	469	478	487	496	504	513	522	531	539
496	548	557	566	574	583	592	601	609	618	627
497	636	644	653	662	671	679	688	697	705	714
498	723	732	740	749	758	767	775	784	793	801
499	810	819	827	836	845	854	862	871	880	888
500	897	906	914	923	932	940	949	958	966	975

Proportional parts	
10	
1	1,0
2	2,0
3	3,0
4	4,0
5	5,0
6	6,0
7	7,0
8	8,0
9	9,0
9	
1	0,9
2	1,8
3	2,7
4	3,6
5	4,5
6	5,4
7	6,3
8	7,2
9	8,1
8	
1	0,8
2	1,6
3	2,4
4	3,2
5	4,0
6	4,8
7	5,6
8	6,4
9	7,2

N. 0 1 2 3 4 5 6 7 8 9 Proportional parts

FIVE-PLACE LOGARITHMS (Continued)

N.	0	1	2	3	4	5	6	7	8	9	Proportional parts
500	69 897	906	914	923	932	940	949	958	966	975	
501	984	992	*001	*010	*018	*027	*036	*044	*053	*062	
502	70 070	079	088	096	105	114	122	131	140	148	
503	157	165	174	183	191	200	209	217	226	234	
504	243	252	260	269	278	286	295	303	312	321	
505	329	338	346	355	364	372	381	389	398	406	
506	415	424	432	441	449	458	467	475	484	492	
507	501	509	518	526	535	544	552	561	569	578	**9**
508	586	595	603	612	621	629	638	646	655	663	1 | 0,9
509	672	680	689	697	706	714	723	731	740	749	2 | 1,8
											3 | 2,7
510	757	766	774	783	791	800	808	817	825	834	4 | 3,6
511	842	851	859	868	876	885	893	902	910	919	5 | 4,5
512	927	935	944	952	961	969	978	986	995	*003	6 | 5,4
513	71 012	020	029	037	046	054	063	071	079	088	7 | 6,3
514	096	105	113	122	130	139	147	155	164	172	8 | 7,2
515	181	189	198	206	214	223	231	240	248	257	9 | 8,1
516	265	273	282	290	299	307	315	324	332	341	
517	349	357	366	374	383	391	399	408	416	425	
518	433	441	450	458	466	475	483	492	500	508	
519	517	525	533	542	550	559	567	575	584	592	
520	600	609	617	625	634	642	650	659	667	675	**8**
521	684	692	700	709	717	725	734	742	750	759	1 | 0,8
522	767	775	784	792	800	809	817	825	834	842	2 | 1,6
523	850	858	867	875	883	892	900	908	917	925	3 | 2,4
524	933	941	950	958	966	975	983	991	999	*008	4 | 3,2
525	72 016	024	032	041	049	057	066	074	082	090	5 | 4,0
526	099	107	115	123	132	140	148	156	165	173	6 | 4,8
527	181	189	198	206	214	222	230	239	247	255	7 | 5,6
528	263	272	280	288	296	304	313	321	329	337	8 | 6,4
529	346	354	362	370	378	387	395	403	411	419	9 | 7,2
530	428	436	444	452	460	469	477	485	493	501	
531	509	518	526	534	542	550	558	567	575	583	
532	591	599	607	616	624	632	640	648	656	665	
533	673	681	689	697	705	713	722	730	738	746	
534	754	762	770	779	787	795	803	811	819	827	
535	835	843	852	860	868	876	884	892	900	908	**7**
536	916	925	933	941	949	957	965	973	981	989	1 | 0,7
537	997	*006	*014	*022	*030	*038	*046	*054	*062	*070	2 | 1,4
538	73 078	086	094	102	111	119	127	135	143	151	3 | 2,1
539	159	167	175	183	191	199	207	215	223	231	4 | 2,8
											5 | 3,5
540	239	247	255	263	272	280	288	296	304	312	6 | 4,2
541	320	328	336	344	352	360	368	376	384	392	7 | 4,9
542	400	408	416	424	432	440	448	456	464	472	8 | 5,6
543	480	488	496	504	512	520	528	536	544	552	9 | 6,3
544	560	568	576	584	592	600	608	616	624	632	
545	640	648	656	664	672	679	687	695	703	711	
546	719	727	735	743	751	759	767	775	783	791	
547	799	807	815	823	830	838	846	854	862	870	
548	878	886	894	902	910	918	926	933	941	949	
549	957	965	973	981	989	997	*005	*013	*020	*028	
550	74 036	044	052	060	068	076	084	092	099	107	

N.	0	1	2	3	4	5	6	7	8	9	Proportional parts

FIVE-PLACE LOGARITHMS (Continued)

N.	0	1	2	3	4	5	6	7	8	9	Proportional parts
550	74 036	044	052	060	068	076	084	092	099	107	
551	115	123	131	139	147	155	162	170	178	186	
552	194	202	210	218	225	233	241	249	257	265	
553	273	280	288	296	304	312	320	327	335	343	
554	351	359	367	374	382	390	398	406	414	421	
555	429	437	445	453	461	468	476	484	492	500	
556	507	515	523	531	539	547	554	562	570	578	
557	586	593	601	609	617	624	632	640	648	656	
558	663	671	679	687	695	702	710	718	726	733	
559	741	749	757	764	772	780	788	796	803	811	
560	819	827	834	842	850	858	865	873	881	889	**8**
561	896	904	912	920	927	935	943	950	958	966	1 | 0,8
562	974	981	989	997	*005	*012	*020	*028	*035	*043	2 | 1,6
563	75 051	059	066	074	082	089	097	105	113	120	3 | 2,4
564	128	136	143	151	159	166	174	182	189	197	4 | 3,2
565	205	213	220	228	236	243	251	259	266	274	5 | 4,0
566	282	289	297	305	312	320	328	335	343	351	6 | 4,8
567	358	366	374	381	389	397	404	412	420	427	7 | 5,6
568	435	442	450	458	465	473	481	488	496	504	8 | 6,4
569	511	519	526	534	542	549	557	565	572	580	9 | 7,2
570	587	595	603	610	618	626	633	641	648	656	
571	664	671	679	686	694	702	709	717	724	732	
572	740	747	755	762	770	778	785	793	800	808	
573	815	823	831	838	846	853	861	868	876	884	
574	891	899	906	914	921	929	937	944	952	959	
575	967	974	982	989	997	*005	*012	*020	*027	*035	
576	76 042	050	057	065	072	080	087	095	103	110	
577	118	125	133	140	148	155	163	170	178	185	
578	193	200	208	215	223	230	238	245	253	260	
579	268	275	283	290	298	305	313	320	328	335	
580	343	350	358	365	373	380	388	395	403	410	**7**
581	418	425	433	440	448	455	462	470	477	485	1 | 0,7
582	492	500	507	515	522	530	537	545	552	559	2 | 1,4
583	567	574	582	589	597	604	612	619	626	634	3 | 2,1
584	641	649	656	664	671	678	686	693	701	708	4 | 2,8
585	716	723	730	738	745	753	760	768	775	782	5 | 3,5
586	790	797	805	812	819	827	834	842	849	856	6 | 4,2
587	864	871	879	886	893	901	908	916	923	930	7 | 4,9
588	938	945	953	960	967	975	982	989	997	*004	8 | 5,6
589	77 012	019	026	034	041	048	056	063	070	078	9 | 6,3
590	085	093	100	107	115	122	129	137	144	151	
591	159	166	173	181	188	195	203	210	217	225	
592	232	240	247	254	262	269	276	283	291	298	
593	305	313	320	327	335	342	349	357	364	371	
594	379	386	393	401	408	415	422	430	437	444	
595	452	459	466	474	481	488	495	503	510	517	
596	525	532	539	546	554	561	568	576	583	590	
597	597	605	612	619	627	634	641	648	656	663	
598	670	677	685	692	699	706	714	721	728	735	
599	743	750	757	764	772	779	786	793	801	808	
600	815	822	830	837	844	851	859	866	873	880	

N.	0	1	2	3	4	5	6	7	8	9	Proportional parts

FIVE-PLACE LOGARITHMS (Continued)

N.	0	1	2	3	4	5	6	7	8	9	Proportional parts
600	77 815	822	830	837	844	851	859	866	873	880	
601	887	895	902	909	916	924	931	938	945	952	
602	960	967	974	981	988	996	*003	*010	*017	*025	
603	78 032	039	046	053	061	068	075	082	089	097	
604	104	111	118	125	132	140	147	154	161	168	
605	176	183	190	197	204	211	219	226	233	240	
606	247	254	262	269	276	283	290	297	305	312	
607	319	326	333	340	347	355	362	369	376	383	**8**
608	390	398	405	412	419	426	433	440	447	455	1 | 0,8
609	462	469	476	483	490	497	504	512	519	526	2 | 1,6
											3 | 2,4
610	533	540	547	554	561	569	576	583	590	597	4 | 3,2
611	604	611	618	625	633	640	647	654	661	668	5 | 4,0
612	675	682	689	696	704	711	718	725	732	739	6 | 4,8
613	746	753	760	767	774	781	789	796	803	810	7 | 5,6
614	817	824	831	838	845	852	859	866	873	880	8 | 6,4
615	888	895	902	909	916	923	930	937	944	951	9 | 7,2
616	958	965	972	979	986	993	*000	*007	*014	*021	
617	79 029	036	043	050	057	064	071	078	085	092	
618	099	106	113	120	127	134	141	148	155	162	
619	169	176	183	190	197	204	211	218	225	232	
620	239	246	253	260	267	274	281	288	295	302	**7**
621	309	316	323	330	337	344	351	358	365	372	1 | 0,7
622	379	386	393	400	407	414	421	428	435	442	2 | 1,4
623	449	456	463	470	477	484	491	498	505	511	3 | 2,1
624	518	525	532	539	546	553	560	567	574	581	4 | 2,8
625	588	595	602	609	616	623	630	637	644	650	5 | 3,5
626	657	664	671	678	685	692	699	706	713	720	6 | 4,2
627	727	734	741	748	754	761	768	775	782	789	7 | 4,9
628	796	803	810	817	824	831	837	844	851	858	8 | 5,6
629	865	872	879	886	893	900	906	913	920	927	9 | 6,3
630	934	941	948	955	962	969	975	982	989	996	
631	80 003	010	017	024	030	037	044	051	058	065	
632	072	079	085	092	099	106	113	120	127	134	
633	140	147	154	161	168	175	182	188	195	202	
634	209	216	223	229	236	243	250	257	264	271	
635	277	284	291	298	305	312	318	325	332	339	**6**
636	346	353	359	366	373	380	387	393	400	407	1 | 0 6
637	414	421	428	434	441	448	455	462	468	475	2 | 1,2
638	482	489	496	502	509	516	523	530	536	543	3 | 1,8
639	550	557	564	570	577	584	591	598	604	611	4 | 2,4
											5 | 3,0
640	618	625	632	638	645	652	659	665	672	679	6 | 3,6
641	686	693	699	706	713	720	726	733	740	747	7 | 4,2
642	754	760	767	774	781	787	794	801	808	814	8 | 4,8
643	821	828	835	841	848	855	862	868	875	882	9 | 5,4
644	889	895	902	909	916	922	929	936	943	949	
645	956	963	969	976	983	990	996	*003	*010	*017	
646	81 023	030	037	043	050	057	064	070	077	084	
647	090	097	104	111	117	124	131	137	144	151	
648	158	164	171	178	184	191	198	204	211	218	
649	224	231	238	245	251	258	265	271	278	285	
650	291	298	305	311	318	325	331	338	345	351	

N.	0	1	2	3	4	5	6	7	8	9	Proportional parts

FIVE-PLACE LOGARITHMS (Continued)

N.	0	1	2	3	4	5	6	7	8	9
650	81 291	298	305	311	318	325	331	338	345	351
651	358	365	371	378	385	391	398	405	411	418
652	425	431	438	445	451	458	465	471	478	485
653	491	498	505	511	518	525	531	538	544	551
654	558	564	571	578	584	591	598	604	611	617
655	624	631	637	644	651	657	664	671	677	684
656	690	697	704	710	717	723	730	737	743	750
657	757	763	770	776	783	790	796	803	809	816
658	823	829	836	842	849	856	862	869	875	882
659	889	895	902	908	915	921	928	935	941	948
660	954	961	968	974	981	987	994	*000	*007	*014
661	82 020	027	033	040	046	053	060	066	073	079
662	086	092	099	105	112	119	125	132	138	145
663	151	158	164	171	178	184	191	197	204	210
664	217	223	230	236	243	249	256	263	269	276
665	282	289	295	302	308	315	321	328	334	341
666	347	354	360	367	373	380	387	393	400	406
667	413	419	426	432	439	445	452	458	465	471
668	478	484	491	497	504	510	517	523	530	536
669	543	549	556	562	569	575	582	588	595	601
670	607	614	620	627	633	640	646	653	659	666
671	672	679	685	692	698	705	711	718	724	730
672	737	743	750	756	763	769	776	782	789	795
673	802	808	814	821	827	835	840	847	853	860
674	866	872	879	885	892	898	905	911	918	924
675	930	937	943	950	956	963	969	975	982	988
676	995	*001	*008	*014	*020	*027	*033	*040	*046	*052
677	83 059	065	072	078	085	091	097	104	110	117
678	123	129	136	142	149	155	161	168	174	181
679	187	193	200	206	213	219	225	232	238	245
680	251	257	264	270	276	283	289	296	302	308
681	315	321	327	334	340	347	353	359	366	372
682	378	385	391	398	404	410	417	423	429	436
683	442	448	455	461	467	474	480	487	493	499
684	506	512	518	525	531	537	544	550	556	563
685	569	575	582	588	594	601	607	613	620	626
686	632	639	645	651	658	664	670	677	683	689
687	696	702	708	715	721	727	734	740	746	753
688	759	765	771	778	784	790	797	803	809	816
689	822	828	835	841	847	853	830	866	872	879
690	885	891	897	904	910	916	923	929	935	942
691	948	954	960	967	973	979	985	992	998	*004
692	84 011	017	023	029	036	042	048	055	061	067
693	073	080	086	092	098	105	111	117	123	130
694	136	142	148	155	161	167	173	180	186	192
695	198	205	211	217	223	230	236	242	248	255
696	261	267	273	280	286	292	298	305	311	317
697	323	330	336	342	348	354	361	367	373	379
698	386	392	398	404	410	417	423	429	435	442
699	448	454	460	466	473	479	485	491	497	504
700	510	516	522	528	535	541	547	553	559	566

Proportional parts	
	7
1	0,7
2	1,4
3	2,1
4	2,8
5	3,5
6	4,2
7	4,9
8	5,6
9	6,3

Proportional parts	
	6
1	0,6
2	1,2
3	1,8
4	2,4
5	3,0
6	3,6
7	4,2
8	4,8
9	5,4

N.	0	1	2	3	4	5	6	7	8	9	Proportional parts

FIVE-PLACE LOGARITHMS (Continued)

N.	0	1	2	3	4	5	6	7	8	9
700	84 510	516	522	528	535	541	547	553	559	566
701	572	578	584	590	597	603	609	615	621	628
702	634	640	646	652	658	665	671	677	683	689
703	696	702	708	714	720	726	733	739	745	751
704	757	763	770	776	782	788	794	800	807	813
705	819	825	831	837	844	850	856	862	868	874
706	880	887	893	899	905	911	917	924	930	936
707	942	948	954	960	967	973	979	985	991	997
708	85 003	009	016	022	028	034	040	046	052	058
709	065	071	077	083	089	095	101	107	114	120
710	126	132	138	144	150	156	163	169	175	181
711	187	193	199	205	211	217	224	230	236	242
712	248	254	260	266	272	278	285	291	297	303
713	309	315	321	327	333	339	345	352	358	364
714	370	376	382	388	394	400	406	412	418	425
715	431	437	443	449	455	461	467	473	479	485
716	491	497	503	509	516	522	528	534	540	546
717	552	558	564	570	576	582	588	594	600	606
718	612	618	625	631	637	643	649	655	661	667
719	673	679	685	691	697	703	709	715	721	727
720	733	739	745	751	757	763	769	775	781	788
721	794	800	806	812	818	824	830	836	842	848
722	854	860	866	872	878	884	890	896	902	908
723	914	920	926	932	938	944	950	956	962	968
724	974	980	986	992	998	*004	*010	*016	*022	*028
725	86 034	040	046	052	058	064	070	076	082	088
726	094	100	106	112	118	124	130	136	141	147
727	153	159	165	171	177	183	189	195	201	207
728	213	219	225	231	237	243	249	255	261	267
729	273	279	285	291	297	303	308	314	320	326
730	332	338	344	350	356	362	368	374	380	386
731	392	398	404	410	415	421	427	433	439	445
732	451	457	463	469	475	481	487	493	499	504
733	510	516	522	528	534	540	546	552	558	564
734	570	576	581	587	593	599	605	611	617	623
735	629	635	641	646	652	658	664	670	676	682
736	688	694	700	705	711	717	723	729	735	741
737	747	753	759	764	770	776	782	788	794	800
738	806	812	817	823	829	835	841	847	853	859
739	864	870	876	882	888	894	900	906	911	917
740	923	929	935	941	947	953	958	964	970	976
741	982	988	994	999	*005	*011	*017	*023	*029	*035
742	87 040	046	052	058	064	070	075	081	087	093
743	099	105	111	116	122	128	134	140	146	151
744	157	163	169	175	181	186	192	198	204	210
745	216	221	227	233	239	245	251	256	262	268
746	274	280	286	291	297	303	309	315	320	326
747	332	338	344	349	355	361	367	373	379	384
748	390	396	402	408	413	419	425	431	437	442
749	448	454	460	466	471	477	483	489	495	500
750	506	512	518	523	529	535	541	547	552	558

Proportional parts	
7	
1	0,7
2	1,4
3	2,1
4	2,8
5	3,5
6	4,2
7	4,9
8	5,6
9	6,3
6	
1	0,6
2	1,2
3	1,8
4	2,4
5	3,0
6	3,6
7	4,2
8	4,8
9	5,4
5	
1	0,5
2	1,0
3	1,5
4	2,0
5	2,5
6	3,0
7	3,5
8	4,0
9	4,5

N.	0	1	2	3	4	5	6	7	8	9	Proportional parts

FIVE-PLACE LOGARITHMS (Continued)

N.	0	1	2	3	4	5	6	7	8	9	Proportional parts
750	87 506	512	518	523	529	535	541	547	552	558	
751	564	570	576	581	587	593	599	604	610	616	
752	622	628	633	639	645	651	656	662	668	674	
753	679	685	691	697	703	708	714	720	726	731	
754	737	743	749	754	760	766	772	777	783	789	
755	795	800	806	812	818	823	829	835	841	846	
756	852	858	864	869	875	881	887	892	898	904	
757	910	915	921	927	933	938	944	950	955	961	
758	967	973	978	984	990	996	*001	*007	*013	*018	
759	88 024	030	036	041	047	053	058	064	070	076	
760	081	087	093	098	104	110	116	121	127	133	6
761	138	144	150	156	161	167	173	178	184	190	1 | 0,6
762	195	201	207	213	218	224	230	235	241	247	2 | 1,2
763	252	258	264	270	275	281	287	292	298	304	3 | 1,8
764	309	315	321	326	332	338	343	349	355	360	4 | 2,4
765	366	372	377	383	389	395	400	406	412	417	5 | 3,0
766	423	429	434	440	446	451	457	463	468	474	6 | 3,6
767	480	485	491	497	502	508	513	519	525	530	7 | 4,2
768	536	542	547	553	559	564	570	576	581	587	8 | 4,8
769	593	598	604	610	615	621	627	632	638	643	9 | 5,4
770	649	655	660	666	672	677	683	689	694	700	
771	705	711	717	722	728	734	739	745	750	756	
772	762	767	773	779	784	790	795	801	807	812	
773	818	824	829	835	840	846	852	857	863	868	
774	874	880	885	891	897	902	908	913	919	925	
775	930	936	941	947	953	958	964	969	975	981	
776	986	992	997	*003	*009	*014	*020	*025	*031	*037	
777	89 042	048	053	059	064	070	076	081	087	092	
778	098	104	109	115	120	126	131	137	143	148	
779	154	159	165	170	176	182	187	193	198	204	
780	209	215	221	226	232	237	243	248	254	260	5
781	265	271	276	282	287	293	298	304	310	315	1 | 0,5
782	321	326	332	337	343	348	354	360	365	371	2 | 1,0
783	376	382	387	393	398	404	409	415	421	426	3 | 1,5
784	432	437	443	448	454	459	465	470	476	481	4 | 2,0
785	487	492	498	504	509	515	520	526	531	537	5 | 2,5
786	542	548	553	559	564	570	575	581	586	592	6 | 3,0
787	597	603	609	614	620	625	631	636	642	647	7 | 3,5
788	653	658	664	669	675	680	686	691	697	702	8 | 4,0
789	708	713	719	724	730	735	741	746	752	757	9 | 4,5
790	763	768	774	779	785	790	796	801	807	812	
791	818	823	829	834	840	845	851	856	862	867	
792	873	878	883	889	894	900	905	911	916	922	
793	927	933	938	944	949	955	960	966	971	977	
794	982	988	993	998	*004	*009	*015	*020	*026	*031	
795	90 037	042	048	053	059	064	069	075	080	086	
796	091	097	102	108	113	119	124	129	135	140	
797	146	151	157	162	168	173	179	184	189	195	
798	200	206	211	217	222	227	233	238	244	249	
799	255	260	266	271	276	282	287	293	298	304	
800	309	314	320	325	331	336	342	347	352	358	

N.	0	1	2	3	4	5	6	7	8	9	Proportional parts

FIVE-PLACE LOGARITHMS (Continued)

N.	0	1	2	3	4	5	6	7	8	9	Proportional parts
800	90 309	314	320	325	331	336	342	347	352	358	
801	363	369	374	380	385	390	396	401	407	412	
802	417	423	428	434	439	445	450	455	461	466	
803	472	477	482	488	493	499	504	509	515	520	
804	526	531	536	542	547	553	558	563	569	574	
805	580	585	590	596	601	607	612	617	623	628	
806	634	639	644	650	655	660	666	671	677	682	
807	687	693	698	703	709	714	720	725	730	736	
808	741	747	752	757	763	768	773	779	784	789	
809	795	800	806	811	816	822	827	832	838	843	
810	849	854	859	865	870	875	881	886	891	897	**6**
811	902	907	913	918	924	929	934	940	945	950	1 | 0,6
812	956	961	966	972	977	982	988	993	998	*004	2 | 1,2
813	91 009	014	020	025	030	036	041	046	052	057	3 | 1,8
814	062	068	073	078	084	089	094	100	105	110	4 | 2,4
815	116	121	126	132	137	142	148	153	158	164	5 | 3,0
816	169	174	180	185	190	196	201	206	212	217	6 | 3,6
817	222	228	233	238	243	249	254	259	265	270	7 | 4,2
818	275	281	286	291	297	302	307	312	318	323	8 | 4,8
819	328	334	339	344	350	355	360	365	371	376	9 | 5,4
820	381	387	392	397	403	408	413	418	424	429	
821	434	440	445	450	455	461	466	471	477	482	
822	487	492	498	503	508	514	519	524	529	535	
823	540	545	551	556	561	566	572	577	582	587	
824	593	598	603	609	614	619	624	630	635	640	
825	645	651	656	661	666	672	677	682	687	693	
826	698	703	709	714	719	724	730	735	740	745	
827	751	756	761	766	772	777	782	787	793	798	
828	803	808	814	819	824	829	834	840	845	850	
829	855	861	866	871	876	882	887	892	897	903	
830	908	913	918	924	929	934	939	944	950	955	**5**
831	960	965	971	976	981	986	991	997	*002	*007	1 | 0,5
832	92 012	018	023	028	033	038	044	049	054	059	2 | 1,0
833	065	070	075	080	085	091	096	101	106	111	3 | 1,5
834	117	122	127	132	137	143	148	153	158	163	4 | 2,0
835	169	174	179	184	189	195	200	205	210	215	5 | 2,5
836	221	226	231	236	241	247	252	257	262	267	6 | 3,0
837	273	278	283	288	293	298	304	309	314	319	7 | 3,5
838	324	330	335	340	345	350	355	361	366	371	8 | 4,0
839	376	381	387	392	397	402	407	412	418	423	9 | 4,5
840	428	433	438	443	449	454	459	464	469	474	
841	480	485	490	495	500	505	511	516	521	526	
842	531	536	542	547	552	557	562	567	572	578	
843	583	588	593	598	603	609	614	619	624	629	
844	634	639	645	650	655	660	665	670	675	681	
845	686	691	696	701	706	711	716	722	727	732	
846	737	742	747	752	758	763	768	773	778	783	
847	788	793	799	804	809	814	819	824	829	834	
848	840	845	850	855	860	865	870	875	881	886	
849	891	896	901	906	911	916	921	927	932	937	
850	942	947	952	957	962	967	973	978	983	988	
N.	0	1	2	3	4	5	6	7	8	9	Proportional parts

FIVE-PLACE LOGARITHMS (Continued)

N.	0	1	2	3	4	5	6	7	8	9
850	92 942	947	952	957	962	967	973	978	983	988
851	993	998	*003	*008	*013	*018	*024	*029	*034	*039
852	93 044	049	054	059	064	069	075	080	085	090
853	095	100	105	110	115	120	125	131	136	141
854	146	151	156	161	166	171	176	181	186	192
855	197	202	207	212	217	222	227	232	237	242
856	247	252	258	263	268	273	278	283	288	293
857	298	303	308	313	318	323	328	334	339	344
858	349	354	359	364	369	374	379	384	389	394
859	399	404	409	414	420	425	430	435	440	445
860	450	455	460	465	470	475	480	485	490	495
861	500	505	510	515	520	526	531	536	541	546
862	551	556	561	566	571	576	581	586	591	596
863	601	606	611	616	621	626	631	636	641	646
864	651	656	661	666	671	676	682	687	692	697
865	702	707	712	717	722	727	732	737	742	747
866	752	757	762	767	772	777	782	787	792	797
867	802	807	812	817	822	827	832	837	842	847
868	852	857	862	867	872	877	882	887	892	897
869	902	907	912	917	922	927	932	937	942	947
870	952	957	962	967	972	977	982	987	992	997
871	94 002	007	012	017	022	027	032	037	042	047
872	052	057	062	067	072	077	082	086	091	096
873	101	106	111	116	121	126	131	136	141	146
874	151	156	161	166	171	176	181	186	191	196
875	201	206	211	216	221	226	231	236	240	245
876	250	255	260	265	270	275	280	285	290	295
877	300	305	310	315	320	325	330	335	340	345
878	349	354	359	364	369	374	379	384	389	394
879	399	404	409	414	419	424	429	433	438	443
880	448	453	458	463	468	473	478	483	488	493
881	498	503	507	512	517	522	527	532	537	542
882	547	552	557	562	567	571	576	581	586	591
883	596	601	606	611	616	621	626	630	635	640
884	645	650	655	660	665	670	675	680	685	689
885	694	699	704	709	714	719	724	729	734	738
886	743	748	753	758	763	768	773	778	783	787
887	792	797	802	807	812	817	822	827	832	836
888	841	846	851	856	861	866	871	876	880	885
889	890	895	900	905	910	915	919	924	929	934
890	939	944	949	954	959	963	968	973	978	983
891	988	993	998	*002	*007	*012	*017	*022	*027	*032
892	95 036	041	046	051	056	061	066	071	075	080
893	085	090	095	100	105	109	114	119	124	129
894	134	139	143	148	153	158	163	168	173	177
895	182	187	192	197	202	207	211	216	221	226
896	231	236	240	245	250	255	260	265	270	274
897	279	284	289	294	299	303	308	313	318	323
898	328	332	337	342	347	352	357	361	366	371
899	376	381	386	390	395	400	405	410	415	419
900	424	429	434	439	444	448	453	458	463	468

Proportional parts	
	6
1	0,6
2	1,2
3	1,8
4	2,4
5	3,0
6	3,6
7	4,2
8	4,8
9	5,4
	5
1	0,5
2	1,0
3	1,5
4	2,0
5	2,5
6	3,0
7	3,5
8	4,0
9	4,5
	4
1	0,4
2	0,8
3	1,2
4	1,6
5	2,0
6	2,4
7	2,8
8	3,2
9	3,6

FIVE-PLACE LOGARITHMS (Continued)

N.	0	1	2	3	4	5	6	7	8	9	Proportional parts
900	95 424	429	434	439	444	448	453	458	463	468	
901	472	477	482	487	492	497	501	506	511	516	
902	521	525	530	535	540	545	550	554	559	564	
903	569	574	578	583	588	593	598	602	607	612	
904	617	622	626	631	636	641	646	650	655	660	
905	665	670	674	679	684	689	694	698	703	708	
906	713	718	722	727	732	737	742	746	751	756	
907	761	766	770	775	780	785	789	794	799	804	
908	809	813	818	823	828	832	837	842	847	852	
909	856	861	866	871	875	880	885	890	895	899	
910	904	909	914	918	923	928	933	938	942	947	**5**
911	952	957	961	966	971	976	980	985	990	995	1 | 0,5
912	999	*004	*009	*014	*019	*023	*028	*033	*038	*042	2 | 1,0
913	96 047	052	057	061	066	071	076	080	085	090	3 | 1,5
914	095	099	104	109	114	118	123	128	133	137	4 | 2,0
915	142	147	152	156	161	166	171	175	180	185	5 | 2,5
916	190	194	199	204	209	213	218	223	227	232	6 | 3,0
917	237	242	246	251	256	261	265	270	275	280	7 | 3,5
918	284	289	294	298	303	308	313	317	322	327	8 | 4,0
919	332	336	341	346	350	355	360	365	369	374	9 | 4,5
920	379	384	388	393	398	402	407	412	417	421	
921	426	431	435	440	445	450	454	459	464	468	
922	473	478	483	487	492	497	501	506	511	515	
923	520	525	530	534	539	544	548	553	558	562	
924	567	572	577	581	586	591	595	600	605	609	
925	614	619	624	628	633	638	642	647	652	656	
926	661	666	670	675	680	685	689	694	699	703	
927	708	713	717	722	727	731	736	741	745	750	
928	755	759	764	769	774	778	783	788	792	797	
929	802	806	811	816	820	825	830	834	839	844	
930	848	853	858	862	867	872	876	881	886	890	**4**
931	895	900	904	909	914	918	923	928	932	937	1 | 0,4
932	942	946	951	956	960	965	970	974	979	984	2 | 0,8
933	988	993	997	*002	*007	*011	*016	*021	*025	*030	3 | 1,2
934	97 035	039	044	049	053	058	063	067	072	077	4 | 1,6
935	081	086	090	095	100	104	109	114	118	123	5 | 2,0
936	128	132	137	142	146	151	155	160	165	169	6 | 2,4
937	174	179	183	188	192	197	202	206	211	216	7 | 2,8
938	220	225	230	234	239	243	248	253	257	262	8 | 3,2
939	267	271	276	280	285	290	294	299	304	308	9 | 3,6
940	313	317	322	327	331	336	340	345	350	354	
941	359	364	368	373	377	382	387	391	396	400	
942	405	410	414	419	424	428	433	437	442	447	
943	451	456	460	465	470	474	479	483	488	493	
944	497	502	506	511	516	520	525	529	534	539	
945	543	548	552	557	562	566	571	575	580	585	
946	589	594	598	603	607	612	617	621	626	630	
947	635	640	644	649	653	658	663	667	672	676	
948	681	685	690	695	699	704	708	713	717	722	
949	727	731	736	740	745	749	754	759	763	768	
950	772	777	782	786	791	795	800	804	809	813	

N.	0	1	2	3	4	5	6	7	8	9	Proportional parts

FIVE-PLACE LOGARITHMS (Continued)

N.	0	1	2	3	4	5	6	7	8	9
950	97 772	777	782	786	791	795	800	804	809	813
951	818	823	827	832	836	841	845	850	855	859
952	864	868	873	877	882	886	891	896	900	905
953	909	914	918	923	928	932	937	941	946	950
954	955	959	964	968	973	978	982	987	991	996
955	98 000	005	009	014	019	023	028	032	037	041
956	046	050	055	059	064	068	073	078	082	087
957	091	096	100	105	109	114	118	123	127	132
958	137	141	146	150	155	159	164	168	173	177
959	182	186	191	195	200	204	209	214	218	223
960	227	232	236	241	245	250	254	259	263	268
961	272	277	281	286	290	295	299	304	308	313
962	318	322	327	331	336	340	345	349	354	358
963	363	367	372	376	381	385	390	394	399	403
964	408	412	417	421	426	430	435	439	444	448
965	453	457	462	466	471	475	480	484	489	493
966	498	502	507	511	516	520	525	529	534	538
967	543	547	552	556	561	565	570	574	579	583
968	588	592	597	601	605	610	614	619	623	628
969	632	637	641	646	650	655	659	664	668	673
970	677	682	686	691	695	700	704	709	713	717
971	722	726	731	735	740	744	749	753	758	762
972	767	771	776	780	784	789	793	798	802	807
973	811	816	820	825	829	834	838	843	847	851
974	856	860	865	869	874	878	883	887	892	896
975	900	905	909	914	918	923	927	932	936	941
976	945	949	954	958	963	967	972	976	981	985
977	989	994	998	*003	*007	*012	*016	*021	*025	*029
978	99 034	038	043	047	052	056	061	065	069	074
979	078	083	087	092	096	100	105	109	114	118
980	123	127	131	136	140	145	149	154	158	162
981	167	171	176	180	185	189	193	198	202	207
982	211	216	220	224	229	233	238	242	247	251
983	255	260	264	269	273	277	282	286	291	295
984	300	304	308	313	317	322	326	330	335	339
985	344	348	352	357	361	366	370	374	379	383
986	388	392	396	401	405	410	414	419	423	427
987	432	436	441	445	449	454	458	463	467	471
988	476	480	484	489	493	498	502	506	511	515
989	520	524	528	533	537	542	546	550	555	559
990	564	568	572	577	581	585	590	594	599	603
991	607	612	616	621	625	629	634	638	642	647
992	651	656	660	664	669	673	677	682	686	691
993	695	699	704	708	712	717	721	726	730	734
994	739	743	747	752	756	760	765	769	774	778
995	782	787	791	795	800	804	808	813	817	822
996	826	830	835	839	843	848	852	856	861	865
997	870	874	878	883	887	891	896	900	904	909
998	913	917	922	926	930	935	939	944	948	952
999	957	961	965	970	974	978	983	987	991	996
1000	00 000	004	009	013	017	022	026	030	035	039

Proportional parts										
	5									
1	0,5									
2	1,0									
3	1,5									
4	2,0									
5	2,5									
6	3,0									
7	3,5									
8	4,0									
9	4,5									
	4									
1	0,4									
2	0,8									
3	1,2									
4	1,6									
5	2,0									
6	2,4									
7	2,8									
8	3,2									
9	3,6									

N.	0	1	2	3	4	5	6	7	8	9	Proportional parts

LOGARITHMS (Continued)

N.	0	1	2	3	4	5	6	7	8	9	d.
1000	000 0000	0434	0869	1303	1737	2171	2605	3039	3473	3907	43
1001	4341	4775	5208	5642	6076	6510	6943	7377	7810	8244	43
1002	8677	9111	9544	9977	*0411	*0844	*1277	*1710	*2143	*2576	43
1003	001 3009	3442	3875	4308	4741	5174	5607	6039	6472	6905	43
1004	7337	7770	8202	8635	9067	9499	9932	*0364	*0796	*1228	43
1005	002 1661	2093	2525	2957	3389	3821	4253	4685	5116	5548	43
1006	5980	6411	6843	7275	7706	8138	8569	9001	9432	9863	43
1007	003 0295	0726	1157	1588	2019	2451	2882	3313	3744	4174	43
1008	4605	5036	5467	5898	6328	6759	7190	7620	8051	8481	43
1009	8912	9342	9772	*0203	*0633	*1063	*1493	*1924	*2354	*2784	43
1010	004 3214	3644	4074	4504	4933	5363	5793	6223	6652	7082	43
1011	7512	7941	8371	8800	9229	9659	*0088	*0517	*0947	*1376	42
1012	005 1805	2234	2663	3092	3521	3950	4379	4808	5237	5666	42
1013	6094	6523	6952	7380	7809	8238	8666	9094	9523	9951	42
1014	006 0380	0808	1236	1664	2092	2521	2949	3377	3805	4233	42
1015	4660	5088	5516	5944	6372	6799	7227	7655	8082	8510	42
1016	8937	9365	9792	*0219	*0647	*1074	*1501	*1923	*2355	*2782	42
1017	007 3210	3637	4064	4490	4917	5344	5771	6198	6624	7051	42
1018	7478	7904	8331	8757	9184	9610	*0037	*0463	*0889	*1316	42
1019	008 1742	2168	2594	3020	3446	3872	4298	4724	5150	5576	42
1020	6002	6427	6853	7279	7704	8130	8556	8981	9407	9832	42
1021	009 0257	0683	1108	1533	1959	2384	2809	3234	3659	4084	42
1022	4509	4934	5359	5784	6208	6633	7058	7483	7907	8332	42
1023	8756	9181	9605	*0030	*0454	*0878	*1303	*1727	*2151	*2575	42
1024	010 3000	3424	3848	4272	4696	5120	5544	5967	6391	6815	42
1025	7239	7662	8086	8510	8933	9357	9780	*0204	*0627	*1050	42
1026	011 1474	1897	2320	2743	3166	3590	4013	4436	4859	5282	42
1027	5704	6127	6550	6973	7396	7818	8241	8664	9086	9509	42
1028	9931	*0354	*0776	*1198	*1621	*2043	*2465	*2887	*3310	*3732	42
1029	012 4154	4576	4998	5420	5842	6264	6685	7107	7529	7951	42
1030	8372	8794	9215	9637	*0059	*0480	*0901	*1323	*1744	*2165	42
1031	013 2587	3008	3429	3850	4271	4692	5113	5534	5955	6376	42
1032	6797	7218	7639	8059	8480	8901	9321	9742	*0162	*0583	42
1033	014 1003	1424	1844	2264	2685	3105	3525	3945	4365	4785	42
1034	5205	5625	6045	6465	6885	7305	7725	8144	8564	8984	42
1035	9403	9823	*0243	*0662	*1082	*1501	*1920	*2340	*2759	*3178	42
1036	015 3598	4017	4436	4855	5274	5693	6112	6531	6950	7369	41
1037	7788	8206	8625	9044	9462	9881	*0300	*0718	*1137	*1555	41
1038	016 1974	2392	2810	3229	3647	4065	4483	4901	5319	5737	41
1039	6155	6573	6991	7409	7827	8245	8663	9080	9498	9916	41
1040	017 0333	0751	1168	1586	2003	2421	2838	3256	3673	4090	41
1041	4507	4924	5342	5759	6176	6593	7010	7427	7844	8260	41
1042	8677	9094	9511	9927	*0344	*0761	*1177	*1594	*2010	*2427	41
1043	018 2843	3259	3676	4092	4508	4925	5341	5757	6173	6589	41
1044	7005	7421	7837	8253	8669	9084	9500	9916	*0332	*0747	41
1045	019 1163	1578	1994	2410	2825	3240	3656	4071	4486	4902	41
1046	5317	5732	6147	6562	6977	7392	7807	8222	8637	9052	41
1047	9467	9882	*0296	*0711	*1126	*1540	*1955	*2369	*2784	*3198	41
1048	020 3613	4027	4442	4856	5270	5684	6099	6513	6927	7341	41
1049	7755	8169	8583	8997	9411	9824	*0238	*0652	*1066	*1479	41
1050	021 1893	2307	2720	3134	3547	3961	4374	4787	5201	5614	41

N.	0	1	2	3	4	5	6	7	8	9

LOGARITHMS (Continued)

N.	0	1	2	3	4	5	6	7	8	9	d.
1050	021 1893	2307	2720	3134	3547	3961	4374	4787	5201	5614	413
1051	6027	6440	6854	7267	7680	8093	8506	8919	9332	9745	413
1052	022 0157	0570	0983	1396	1808	2221	2634	3046	3459	3871	413
1053	4284	4696	5109	5521	5933	6345	6758	7170	7582	7994	412
1054	8406	8818	9230	9642	*0054	*0466	*0878	*1289	*1701	*2113	412
1055	023 2525	2936	3348	3759	4171	4582	4994	5405	5817	6228	411
1056	6639	7050	7462	7873	8284	8695	9106	9517	9928	*0339	411
1057	024 0750	1161	1572	1982	2393	2804	3214	3625	4036	4446	411
1058	4857	5267	5678	6088	6498	6909	7319	7729	8139	8549	410
1059	8960	9370	9780	*0190	*0600	*1010	*1419	*1829	*2239	*2649	410
1060	025 3059	3468	3878	4288	4697	5107	5516	5926	6335	6744	410
1061	7154	7563	7972	8382	8791	9200	9609	*0018	*0427	*0836	409
1062	026 1245	1654	2063	2472	2881	3289	3698	4107	4515	4924	409
1063	5333	5741	6150	6558	6967	7375	7783	8192	8600	9008	408
1064	9416	9824	*0233	*0641	*1049	*1457	*1865	*2273	*2680	*3088	408
1065	027 3496	3904	4312	4719	5127	5535	5942	6350	6757	7165	408
1066	7572	7979	8387	8794	9201	9609	*0016	*0423	*0830	*1237	407
1067	028 1644	2051	2458	2865	3272	3679	4086	4492	4899	5306	407
1068	5713	6119	6526	6932	7339	7745	8152	8558	8964	9371	406
1069	9777	*0183	*0590	*0996	*1402	*1808	*2214	*2620	*3026	*3432	406
1070	029 3838	4244	4649	5055	5461	5867	6272	6678	7084	7489	406
1071	7895	8300	8706	9111	9516	9922	*0327	*0732	*1138	*1543	405
1072	030 1948	2353	2758	3163	3468	3973	4378	4783	5188	5592	405
1073	5997	6402	6807	7211	7616	8020	8425	8830	9234	9638	405
1074	031 0043	0447	0851	1256	1660	2064	2468	2872	3277	3681	404
1075	4085	4489	4893	5296	5700	6104	6508	6912	7315	7719	404
1076	8123	8526	8930	9333	9737	*0140	*0544	*0947	*1350	*1754	403
1077	032 2157	2560	2963	3367	3770	4173	4576	4979	5382	5785	405
1078	6188	6590	6993	7396	7799	8201	8604	9007	9409	9812	403
1079	033 0214	0617	1019	1422	1824	2226	2629	3031	3433	3835	402
1080	4238	4640	5042	5444	5846	6248	6650	7052	7453	7855	402
1081	8257	8659	9060	9462	9864	*0265	*0667	*1068	*1470	*1871	402
1082	034 2273	2674	3075	3477	3878	4279	4680	5081	5482	5884	401
1083	6285	6686	7087	7487	7888	8289	8690	9091	9491	9892	401
1084	035 0293	0693	1094	1495	1895	2296	2696	3096	3497	3897	400
1085	4297	4698	5098	5498	5898	6298	6698	7098	7498	7898	400
1086	8298	8698	9098	9498	9898	*0297	*0697	*1097	*1496	*1896	400
1087	036 2295	2695	3094	3494	3893	4293	4692	5091	5491	5890	399
1088	6289	6688	7087	7486	7885	8284	8683	9082	9481	9880	399
1089	037 0279	0678	1076	1475	1874	2272	2671	3070	3468	3867	399
1090	4265	4663	5062	5460	5858	6257	6655	7053	7451	7849	398
1091	8248	8646	9044	9442	9839	*0237	*0635	*1033	*1431	*1829	398
1092	038 2226	2624	3022	3419	3817	4214	4612	5009	5407	5804	398
1093	6202	6599	6996	7393	7791	8188	8585	8982	9379	9776	397
1094	039 0173	0570	0967	1364	1761	2158	2554	2951	3348	3745	397
1095	4141	4538	4934	5331	5727	6124	6520	6917	7313	7709	397
1096	8106	8502	8898	9294	9690	*0086	*0482	*0878	*1274	*1670	396
1097	040 2066	2462	2858	3254	3650	4045	4441	4837	5232	5628	396
1098	6023	6419	6814	7210	7605	8001	8396	8791	9187	9582	395
1099	9977	*0372	*0767	*1162	*1557	*1952	*2347	*2742	*3137	*3532	395
1100	041 3927	4322	4716	5111	5506	5900	6295	6690	7084	7479	395

N.	0	1	2	3	4	5	6	7	8	9	d.

LOGARITHMS OF THE TRIGONOMETRIC FUNCTIONS

Logarithms of the functions are given for each minute from 0–360°.

The quantity −10 is to be appended to all logarithms of the sine and cosine, to logarithms of the tangent from 0–45° and of the cotangent from 45–90°.

With degrees indicated at either side of the top of the page use the column headings at the top. With degrees stated at the bottom of the page use the column designations at the bottom.

With degrees at the left (top or bottom) use the minute column at the left, and with degrees on the right side of the page use the minute column at the right.

For the accurate determination of values where the tabular differences are large, the values of CS and CT are given. The following equations indicate their use:

To find the logarithm of the function of an angle.

For angles 0–3°	For angles 87–90°
$\log \sin \theta = \log \theta'' - CS$	$\log \cos \theta = \log (90° - \theta)'' - CS$
$\log \tan \theta = \log \theta'' - CT$	$\log \cot \theta = \log (90° - \theta)'' - CT$
$\log \cot \theta = \operatorname{colog} \tan \theta$	$\log \tan \theta = \operatorname{colog} \cot \theta$

To find the angle.

For angles 0–3°	For angles 87–90°
$\log \theta'' = \log \sin \theta + CS$	$\log (90° - \theta)'' = \log \cos \theta + CS$
$\log \theta'' = \log \tan \theta + CT$	$\log (90° - \theta)'' = \log \cot \theta + CT$

In the above expressions, θ'' and $(90° - \theta)''$ are used to indicate the value of the angles expressed in seconds. The values in the body of the table are the co-logarithms and should be used as indicated above.

The values of the logarithms S and T are also given in a separate table. For these the following relations hold:

To find the function of an angle.

$\log \sin \theta = \log \theta'' + S$	$\log \cos \theta = \log (90° - \theta)'' + S$
$\log \tan \theta = \log \theta'' + T$	$\log \cot \theta = \log (90° - \theta)'' + T$

To find the angle.

$\log \theta'' = \log \sin \theta - S$	$\log (90 - \theta)'' = \log \cos \theta - S$
$\log \theta'' = \log \tan \theta - T$	$\log (90 - \theta)'' = \log \cot \theta - T$

Mins.	Values of S, −10 to be appended					Values of T, −10 to be appended					Sec.
	0°	1°	2°	3°	4°	0°	1°	2°	3°	4°	
0′	4.68 558	555	549	538	522	4.68 558	562	575	597	628	0″
1	558	555	549	537	522	558	562	575	598	629	60
2	558	555	548	537	522	558	562	576	598	629	120
3	558	555	548	537	521	558	562	576	599	630	180
4	558	555	548	537	521	558	563	576	599	631	240
5	558	555	548	537	521	558	563	577	599	631	300
6	558	555	548	536	520	558	563	577	600	632	360
7	558	555	548	536	520	558	563	577	600	632	420
8	557	555	548	536	520	558	563	578	601	633	480
9	557	555	547	536	520	558	563	578	601	634	540
10	4.68 557	555	547	535	519	4.68 558	564	578	602	634	600
11	557	554	547	535	519	558	564	579	602	635	660
12	557	554	547	535	519	558	564	579	603	635	720
13	557	554	547	535	518	558	564	579	603	636	780
14	557	554	547	534	518	558	564	580	604	637	840
15	557	554	546	534	518	558	564	580	604	637	900
16	557	554	546	534	517	558	565	580	605	638	960
17	557	554	546	534	517	558	565	581	605	639	1020
18	557	554	546	534	517	558	565	581	606	639	1080
19	557	554	546	533	516	558	565	581	606	640	1140
20	4.68 557	554	546	533	516	4.68 558	565	582	607	640	1200
21	557	554	545	533	516	558	566	582	607	641	1260
22	557	553	545	533	515	558	566	582	608	642	1320
23	557	553	545	532	515	558	566	583	608	642	1380
24	557	553	545	532	515	558	566	583	609	643	1440
25	557	553	545	532	515	558	566	583	609	644	1500
26	557	553	544	532	514	558	567	584	610	644	1560
27	557	553	544	531	514	558	567	584	610	645	1620
28	557	553	544	531	514	558	567	584	611	646	1680
29	557	553	544	531	513	559	567	585	611	646	1740
30	4.68 557	553	544	531	513	4.68 559	567	585	612	647	1800
31	557	552	544	530	513	559	568	585	612	648	1860
32	557	552	543	530	512	559	568	586	613	648	1920
33	557	552	543	530	512	559	568	586	613	649	1980
34	557	552	543	529	512	559	568	587	614	650	2040
35	557	552	543	529	511	559	569	587	614	650	2100
36	557	552	543	529	511	559	569	587	615	651	2160
37	557	552	542	529	511	559	569	588	615	652	2220
38	557	552	542	528	510	559	569	588	616	652	2280
39	557	552	542	528	510	559	570	589	616	653	2340
40	4.68 557	551	542	528	510	4.68 559	570	589	617	654	2400
41	557	551	542	528	509	560	570	589	617	654	2460
42	556	551	541	527	509	560	570	590	618	655	2520
43	556	551	541	527	508	560	571	590	619	656	2580
44	556	551	541	527	508	560	571	591	619	656	2640
45	556	551	541	527	508	560	571	591	620	657	2700
46	556	551	541	526	507	560	571	591	620	658	2760
47	556	551	540	526	507	560	572	592	621	659	2820
48	556	550	540	526	507	560	572	592	621	659	2880
49	556	550	540	525	506	560	572	593	622	660	2940
50	4.68 556	550	540	525	506	4.68 561	572	593	622	661	3000
51	556	550	540	525	506	561	573	593	623	661	3060
52	556	550	539	525	505	561	573	594	624	662	3120
53	556	550	539	524	505	561	573	594	624	663	3180
54	556	550	539	524	505	561	573	595	625	664	3240
55	556	549	539	524	504	561	574	595	625	664	3300
56	556	549	539	523	504	561	574	596	626	665	3360
57	556	549	538	523	503	562	574	596	626	666	3420
58	555	549	538	523	503	562	575	596	627	667	3480
59	555	549	538	523	503	562	575	597	628	667	3540
60	4.68 555	549	538	522	502	4.68 562	575	597	628	668	3600

0° (180°) — (359°) 179°

″	′	L. Sin	d.	C. S.	C. T.	L. Tan.	c.d.	L. Cot.	L. Cos.	′
0	**0**	—		—	—	—		—	0.00 000	**60**
60	1	6.46 373		5.31 443	5.31 443	6.46 373	30103	3.53 627	0.00 000	59
120	2	6.76 476	30103	5.31 443	5.31 443	6.76 476	17609	3.23 524	0.00 000	58
180	3	6.94 085	17609	5.31 443	5.31 443	6.94 085	12494	3.05 915	0.00 000	57
240	4	7.06 579	12494	5.31 443	5.31 442	7.06 579	9691	2.93 421	0.00 000	56
300	5	7.16 270	9691	5.31 443	5.31 442	7.16 270	7918	2.83 730	0.00 000	55
360	6	7.24 188	7918	5.31 443	5.31 442	7.24 188	6694	2.75 812	0.00 000	54
420	7	7.30 882	6694	5.31 443	5.31 442	7.30 882	5800	2.69 118	0.00 000	53
480	8	7.36 682	5800	5.31 443	5.31 442	7.36 682	5115	2.63 318	0.00 000	52
540	9	7.41 797	5115	5.31 443	5.31 442	7.41 797	4576	2.58 203	0.00 000	51
600	**10**	7.46 373	4576	5.31 443	5.31 442	7.46 373	4139	2.53 627	0.00 000	**50**
660	11	7.50 512	4139	5.31 443	5.31 442	7.50 512	3779	2.49 488	0.00 000	49
720	12	7.54 291	3779	5.31 443	5.31 442	7.54 291	3476	2.45 709	0.00 000	48
780	13	7.57 767	3476	5.31 443	5.31 442	7.57 767	3219	2.42 233	0.00 000	47
840	14	7.60 985	3216	5.31 443	5.31 442	7.60 986	2996	2.39 014	0.00 000	46
900	15	7.63 982	2997	5.31 443	5.31 442	7.63 982	2803	2.36 018	0.00 000	45
960	16	7.66 784	2802	5.31 443	5.31 442	7.66 785	2633	2.33 215	0.00 000	44
1020	17	7.69 417	2633	5.31 443	5.31 442	7.69 418	2482	2.30 582	9.99 999	43
1080	18	7.71 900	2483	5.31 443	5.31 442	7.71 900	2348	2.28 100	9.99 999	42
1140	19	7.74 248	2348	5.31 443	5.31 442	7.74 248	2228	2.25 752	9.99 999	41
1200	**20**	7.76 475	2227	5.31 443	5.31 442	7.76 476	2119	2.23 524	9.99 999	**40**
1260	21	7.78 594	2119	5.31 443	5.31 442	7.78 595	2020	2.21 405	9.99 999	39
1320	22	7.80 615	2021	5.31 443	5.31 442	7.80 615	1931	2.19 385	9.99 999	38
1380	23	7.82 545	1930	5.31 443	5.31 442	7.82 546	1848	2.17 454	9.99 999	37
1440	24	7.84 393	1848	5.31 443	5.31 442	7.84 394	1773	2.15 606	9.99 999	36
1500	25	7.86 166	1773	5.31 443	5.31 442	7.86 167	1704	2.13 833	9.99 999	35
1560	26	7.87 870	1704	5.31 443	5.31 442	7.87 871	1639	2.12 129	9.99 999	34
1620	27	7.89 509	1639	5.31 443	5.31 442	7.89 510	1579	2.10 490	9.99 999	33
1680	28	7.91 088	1579	5.31 443	5.31 442	7.91 089	1524	2.08 911	9.99 999	32
1740	29	7.92 612	1524	5.31 443	5.31 441	7.92 613	1473	2.07 387	9.99 998	31
1800	**30**	7.94 084	1472	5.31 443	5.31 441	7.94 086	1424	2.05 914	9.99 998	**30**
1860	31	7.95 508	1424	5.31 443	5.31 441	7.95 510	1379	2.04 490	9.99 998	29
1920	32	7.96 887	1379	5.31 443	5.31 441	7.96 889	1336	2.03 111	9.99 998	28
1980	33	7.98 223	1336	5.31 443	5.31 441	7.98 225	1297	2.01 775	9.99 998	27
2040	34	7.99 520	1297	5.31 443	5.31 441	7.99 522	1259	2.00 478	9.99 998	26
2100	35	8.00 779	1259	5.31 443	5.31 441	8.00 781	1223	1.99 219	9.99 998	25
2160	36	8.02 002	1223	5.31 443	5.31 441	8.02 004	1190	1.97 996	9.99 998	24
2220	37	8.03 192	1190	5.31 443	5.31 441	8.03 194	1159	1.96 806	9.99 997	23
2280	38	8.04 350	1158	5.31 443	5.31 441	8.04 353	1128	1.95 647	9.99 997	22
2340	39	8.05 478	1128	5.31 443	5.31 441	8.05 481	1100	1.94 519	9.99 997	21
2400	**40**	8.06 578	1100	5.31 443	5.31 441	8.06 581	1072	1.93 419	9.99 997	**20**
2460	41	8.07 650	1072	5.31 444	5.31 440	8.07 653	1047	1.92 347	9.99 997	19
2520	42	8.08 696	1046	5.31 444	5.31 440	8.08 700	1022	1.91 300	9.99 997	18
2580	43	8.09 718	1022	5.31 444	5.31 440	8.09 722	998	1.90 278	9.99 997	17
2640	44	8.10 717	999	5.31 444	5.31 440	8.10 720	976	1.89 280	9.99 996	16
2700	45	8.11 693	976	5.31 444	5.31 440	8.11 696	955	1.88 304	9.99 996	15
2760	46	8.12 647	954	5.31 444	5.31 440	8.12 651	934	1.87 349	9.99 996	14
2820	47	8.13 581	934	5.31 444	5.31 440	8.13 585	915	1.86 415	9.99 996	13
2880	48	8.14 495	914	5.31 444	5.31 440	8.14 500	895	1.85 500	9.99 996	12
2940	49	8.15 391	896	5.31 444	5.31 440	8.15 395	878	1.84 605	9.99 996	11
3000	**50**	8.16 268	877	5.31 444	5.31 439	8.16 273	860	1.83 727	9.99 995	**10**
3060	51	8.17 128	860	5.31 444	5.31 439	8.17 133	843	1.82 867	9.99 995	9
3120	52	8.17 971	843	5.31 444	5.31 439	8.17 976	828	1.82 024	9.99 995	8
3180	53	8.18 798	827	5.31 444	5.31 439	8.18 804	812	1.81 196	9.99 995	7
3240	54	8.19 610	812	5.31 444	5.31 439	8.19 616	797	1.80 384	9.99 995	6
3300	55	8.20 407	797	5.31 444	5.31 439	8.20 413	782	1.79 587	9.99 994	5
3360	56	8.21 189	782	5.31 444	5.31 439	8.21 195	769	1.78 805	9.99 994	4
3420	57	8.21 958	769	5.31 445	5.31 439	8.21 964	756	1.78 036	9.99 994	3
3480	58	8.22 713	755	5.31 445	5.31 438	8.22 720	742	1.77 280	9.99 994	2
3540	59	8.23 456	743	5.31 445	5.31 438	8.23 462	730	1.76 538	9.99 994	1
3600	**60**	8.24 186	730	5.31 445	5.31 438	8.24 192		1.75 808	9.99 993	**0**
	′	L. Cos.	d.			L. Cot.	c.d.	L. Tan.	L. Sin.	′

90° (270°) (269°) 8

″	′	L. Sin.	d.	C. S.	C. T.	L. Tan.	c.d.	L. Cot.	L. Cos.	′
		1° (181°)								(358°) **178°**
3600	**0**	8.24 186	717	5.31 445	5.31 438	8.24 192	718	1.75 808	9.99 993	**60**
3660	1	8.24 903	706	5.31 445	5.31 438	8.24 910	706	1.75 090	9.99 993	59
3720	2	8.25 609	695	5.31 445	5.31 438	8.25 616	696	1.74 384	9.99 993	58
3780	3	8.26 304	684	5.31 445	5.31 438	8.26 312	684	1.73 688	9.99 993	57
3840	4	8.26 988	673	5.31 445	5.31 437	8.26 996	673	1.73 004	9.99 992	56
3900	5	8.27 661	663	5.31 445	5.31 437	8.27 669	663	1.72 331	9.99 992	55
3960	6	8.28 324	653	5.31 445	5.31 437	8.28 332	654	1.71 668	9.99 992	54
4020	7	8.28 977	644	5.31 445	5.31 437	8.28 986	643	1.71 014	9.99 992	53
4080	8	8.29 621	634	5.31 445	5.31 437	8.29 629	634	1.70 371	9.99 992	52
4140	9	8.30 255	624	5.31 445	5.31 437	8.30 263	625	1.69 737	9.99 991	51
4200	**10**	8.30 879	616	5.31 446	5.31 437	8.30 888	617	1.69 112	9.99 991	**50**
4260	11	8.31 495	608	5.31 446	5.31 436	8.31 505	607	1.68 495	9.99 991	49
4320	12	8.32 103	599	5.31 446	5.31 436	8.32 112	599	1.67 888	9.99 990	48
4380	13	8.32 702	590	5.31 446	5.31 436	8.32 711	591	1.67 289	9.99 990	47
4440	14	8.33 292	583	5.31 446	5.31 436	8.33 302	584	1.66 698	9.99 990	46
4500	15	8.33 875	575	5.31 446	5.31 436	8.33 886	575	1.66 114	9.99 990	45
4560	16	8.34 450	568	5.31 446	5.31 435	8.34 461	568	1.65 539	9.99 989	44
4620	17	8.35 018	560	5.31 446	5.31 435	8.35 029	561	1.64 971	9.99 989	43
4680	18	8.35 578	553	5.31 446	5.31 435	8.35 590	553	1.64 410	9.99 989	42
4740	19	8.36 131	547	5.31 446	5.31 435	8.36 143	546	1.63 857	9.99 989	41
4800	**20**	8.36 678	539	5.31 446	5.31 435	8.36 689	540	1.63 311	9.99 988	**40**
4860	21	8.37 217	533	5.31 447	5.31 434	8.37 229	533	1.62 771	9.99 988	39
4920	22	8.37 750	526	5.31 447	5.31 434	8.37 762	527	1.62 238	9.99 988	38
4980	23	8.38 276	520	5.31 447	5.31 434	8.38 289	520	1.61 711	9.99 987	37
5040	24	8.38 796	514	5.31 447	5.31 434	8.38 809	514	1.61 191	9.99 987	36
5100	25	8.39 310	508	5.31 447	5.31 434	8.39 323	509	1.60 677	9.99 987	35
5160	26	8.39 818	502	5.31 447	5.31 433	8.39 832	502	1.60 168	9.99 986	34
5220	27	8.40 320	496	5.31 447	5.31 433	8.40 334	496	1.59 666	9.99 986	33
5280	28	8.40 816	491	5.31 447	5.31 433	8.40 830	491	1.59 170	9.99 986	32
5340	29	8.41 307	485	5.31 447	5.31 433	8.41 321	486	1.58 679	9.99 985	31
5400	**30**	8.41 792	480	5.31 447	5.31 433	8.41 807	480	1.58 193	9.99 985	**30**
5460	31	8.42 272	474	5.31 448	5.31 432	8.42 287	475	1.57 713	9.99 985	29
5520	32	8.42 746	470	5.31 448	5.31 432	8.42 762	470	1.57 238	9.99 984	28
5580	33	8.43 216	464	5.31 448	5.31 432	8.43 232	464	1.56 768	9.99 984	27
5640	34	8.43 680	459	5.31 448	5.31 432	8.43 696	460	1.56 304	9.99 984	26
5700	35	8.44 139	455	5.31 448	5.31 431	8.44 156	455	1.55 844	9.99 983	25
5760	36	8.44 594	450	5.31 448	5.31 431	8.44 611	450	1.55 389	9.99 983	24
5820	37	8.45 044	445	5.31 448	5.31 431	8.45 061	446	1.54 939	9.99 983	23
5880	38	8.45 489	441	5.31 448	5.31 431	8.45 507	441	1.54 493	9.99 982	22
5940	39	8.45 930	436	5.31 449	5.31 431	8.45 948	437	1.54 052	9.99 982	21
6000	**40**	8.46 366	433	5.31 449	5.31 430	8.46 385	432	1.53 615	9.99 982	**20**
6060	41	8.46 799	427	5.31 449	5.31 430	8.46 817	428	1.53 183	9.99 981	19
6120	42	8.47 226	424	5.31 449	5.31 430	8.47 245	424	1.52 755	9.99 981	18
6180	43	8.47 650	419	5.31 449	5.31 430	8.47 669	420	1.52 331	9.99 981	17
6240	44	8.48 069	416	5.31 449	5.31 429	8.48 089	416	1.51 911	9.99 980	16
6300	45	8.48 485	411	5.31 449	5.31 429	8.48 505	412	1.51 495	9.99 980	15
6360	46	8.48 896	408	5.31 449	5.31 429	8.48 917	408	1.51 083	9.99 979	14
6420	47	8.49 304	404	5.31 450	5.31 428	8.49 325	404	1.50 675	9.99 979	13
6480	48	8.49 708	400	5.31 450	5.31 428	8.49 729	401	1.50 271	9.99 979	12
6540	49	8.50 108	396	5.31 450	5.31 428	8.50 130	397	1.49 870	9.99 978	11
6600	**50**	8.50 504	393	5.31 450	5.31 428	8.50 527	393	1.49 473	9.99 978	**10**
6660	51	8.50 897	390	5.31 450	5.31 427	8.50 920	390	1.49 080	9.99 977	9
6720	52	8.51 287	386	5.31 450	5.31 427	8.51 310	386	1.48 690	9.99 977	8
6780	53	8.51 673	382	5.31 450	5.31 427	8.51 696	383	1.48 304	9.99 977	7
6840	54	8.52 055	379	5.31 450	5.31 427	8.52 079	380	1.47 921	9.99 976	6
6900	55	8.52 434	376	5.31 451	5.31 426	8.52 459	376	1.47 541	9.99 976	5
6960	56	8.52 810	373	5.31 451	5.31 426	8.52 835	373	1.47 165	9.99 975	4
7020	57	8.53 183	369	5.31 451	5.31 426	8.53 208	370	1.46 792	9.99 975	3
7080	58	8.53 552	367	5.31 451	5.31 425	8.53 578	367	1.46 422	9.99 974	2
7140	59	8.53 919	363	5.31 451	5.31 425	8.53 945	363	1.46 055	9.99 974	1
7200	**60**	8.54 282		5.31 451	5.31 425	8.54 308		1.45 692	9.99 974	**0**
	′	L. Cos.	d.			L. Cot.	c.d.	L. Tan.	L. Sin.	′
		91° (271°)								(268°) **88°**

N′	′	L. Sin.	d.	C. S.	C. T.	L. Tan.	c.d.	L. Cot.	L. Cos.	′
		2° (182°)							(357°) 177°	
7200	**0**	8.54 282		5.31 451	5.31 425	8.54 308		1.45 692	9.99 974	**60**
7260	1	8.54 642	360	5.31 451	5.31 425	8.54 669	361	1.45 331	9.99 973	59
7320	2	8.54 999	357	5.31 452	5.31 424	8.55 027	358	1.44 973	9.99 973	58
7380	3	8.55 354	355	5.31 452	5.31 424	8.55 382	355	1.44 618	9.99 972	57
7440	4	8.55 705	351	5.31 452	5.31 424	8.55 734	352	1.44 266	9.99 972	56
7500	5	8.56 054	349	5.31 452	5.31 423	8.56 083	349	1.43 917	9.99 971	55
7560	6	8.56 400	346	5.31 452	5.31 423	8.56 429	346	1.43 571	9.99 971	54
7620	7	8.56 743	343	5.31 452	5.31 423	8.56 773	344	1.43 227	9.99 970	53
7680	8	8.57 084	341	5.31 453	5.31 422	8.57 114	341	1.42 886	9.99 970	52
7740	9	8.57 421	337	5.31 453	5.31 422	8.57 452	338	1.42 548	9.99 969	51
7800	**10**	8.57 757	336	5.31 453	5.31 422	8.57 788	336	1.42 212	9.99 969	**50**
7860	11	8.58 089	332	5.31 453	5.31 421	8.58 121	333	1.41 879	9.99 968	49
7920	12	8.58 419	330	5.31 453	5.31 421	8.58 451	330	1.41 549	9.99 968	48
7980	13	8.58 747	328	5.31 453	5.31 421	8.58 779	328	1.41 221	9.99 967	47
8040	14	8.59 072	325	5.31 454	5.31 421	8.59 105	326	1.40 895	9.99 967	46
8100	15	8.59 395	323	5.31 454	5.31 420	8.59 428	323	1.40 572	9.99 967	45
8160	16	8.59 715	320	5.31 454	5.31 420	8.59 749	321	1.40 251	9.99 966	44
8220	17	8.60 033	318	5.31 454	5.31 420	8.60 068	319	1.39 932	9.99 966	43
8280	18	8.60 349	316	5.31 454	5.31 419	8.60 384	316	1.39 616	9.99 965	42
8340	19	8.60 662	313	5.31 454	5.31 419	8.60 698	314	1.39 302	9.99 964	41
8400	**20**	8.60 973	311	5.31 455	5.31 418	8.61 009	311	1.38 991	9.99 964	**40**
8460	21	8.61 282	309	5.31 455	5.31 418	8.61 319	310	1.38 681	9.99 963	39
8520	22	8.61 589	307	5.31 455	5.31 418	8.61 625	307	1.38 374	9.99 963	38
8580	23	8.61 894	305	5.31 455	5.31 417	8.61 931	305	1.38 069	9.99 962	37
8640	24	8.62 196	302	5.31 455	5.31 417	8.62 234	303	1.37 766	9.99 962	36
8700	25	8.62 497	301	5.31 455	5.31 417	8.62 535	301	1.37 465	9.99 961	35
8760	26	8.62 795	298	5.31 456	5.31 416	8.62 834	299	1.37 166	9.99 961	34
8820	27	8.63 091	296	5.31 456	5.31 416	8.63 131	297	1.36 869	9.99 960	33
8880	28	8.63 385	294	5.31 456	5.31 416	8.63 426	295	1.36 574	9.99 960	32
8940	29	8.63 678	293	5.31 456	5.31 415	8.63 718	292	1.36 282	9.99 959	31
9000	**30**	8.63 968	290	5.31 456	5.31 415	8.64 009	291	1.35 991	9.99 959	**30**
9060	31	8.64 256	288	5.31 456	5.31 415	8.64 298	289	1.35 702	9.99 958	29
9120	32	8.64 543	287	5.31 457	5.31 414	8.64 585	287	1.35 415	9.99 958	28
9180	33	8.64 827	284	5.31 457	5.31 414	8.64 870	285	1.35 130	9.99 957	27
9240	34	8.65 110	283	5.31 457	5.31 413	8.65 154	284	1.34 846	9.99 956	26
9300	35	8.65 391	281	5.31 457	5.31 413	8.65 435	281	1.34 565	9.99 956	25
9360	36	8.65 670	279	5.31 457	5.31 413	8.65 715	280	1.34 285	9.99 956	24
9420	37	8.65 947	277	5.31 458	5.31 412	8.65 993	278	1.34 007	9.99 955	23
9480	38	8.66 223	276	5.31 458	5.31 412	8.66 269	276	1.33 731	9.99 954	22
9540	39	8.66 497	274	5.31 458	5.31 412	8.66 543	274	1.33 457	9.99 954	21
9600	**40**	8.66 769	272	5.31 458	5.31 411	8.66 816	273	1.33 184	9.99 953	**20**
9660	41	8.67 039	270	5.31 458	5.31 411	8.67 087	271	1.32 913	9.99 952	19
9720	42	8.67 308	269	5.31 459	5.31 410	8.67 356	269	1.32 644	9.99 952	18
9780	43	8.67 575	267	5.31 459	5.31 410	8.67 624	268	1.32 376	9.99 951	17
9840	44	8.67 841	266	5.31 459	5.31 410	8.67 890	266	1.32 110	9.99 951	16
9900	45	8.68 104	263	5.31 459	5.31 409	8.68 154	264	1.31 846	9.99 950	15
9960	46	8.68 367	263	5.31 459	5.31 409	8.68 417	263	1.31 583	9.99 949	14
10020	47	8.68 627	260	5.31 460	5.31 408	8.68 678	261	1.31 322	9.99 949	13
10080	48	8.68 886	259	5.31 460	5.31 408	8.68 938	260	1.31 062	9.99 948	12
10140	49	8.69 144	258	5.31 460	5.31 408	8.69 196	258	1.30 804	9.99 948	11
10200	**50**	8.69 400	256	5.31 460	5.31 407	8.69 453	257	1.30 547	9.99 947	**10**
10260	51	8.69 654	254	5.31 460	5.31 407	8.69 708	255	1.30 292	9.99 946	9
10320	52	8.69 907	253	5.31 461	5.31 406	8.69 962	254	1.30 038	9.99 946	8
10380	53	8.70 159	252	5.31 461	5.31 406	8.70 214	252	1.29 786	9.99 945	7
10440	54	8.70 409	250	5.31 461	5.31 405	8.70 465	251	1.29 535	9.99 944	6
10500	55	8.70 658	249	5.31 461	5.21 405	8.70 714	249	1.29 286	9.99 944	5
10560	56	8.70 905	247	5.31 461	5.31 405	8.70 962	248	1.29 038	9.99 943	4
10620	57	8.71 151	246	5.31 462	5.31 404	8.71 208	246	1.28 792	9.99 942	3
10680	58	8.71 395	244	5.31 462	5.31 404	8.71 453	245	1.28 547	9.99 942	2
10740	59	8.71 638	243	5.31 462	5.31 403	8.71 697	244	1.28 303	9.99 941	1
10800	**60**	8.71 880	242	5.31 462	5.31 403	8.71 940	243	1.28 060	9.99 940	0
	′	L. Cos.	d.			L. Cot.	c.d.	L. Tan.	L. Sin.	′
		92° (272°)							(267°) 87°	

3° (183°) (356°) 176°

′	L. Sin.	d.	L. Tan.	c.d.	L. Cot.	L. Cos.	′
0	8.71 880	240	8.71 940	241	1.28 060	9.99 940	60
1	8.72 120	239	8.72 181	239	1.27 819	9.99 940	59
2	8.72 359	238	8.72 420	239	1.27 580	9.99 939	58
3	8.72 597	238	8.72 659	237	1.27 341	9.99 938	57
4	8.72 834	237	8.72 896	236	1.27 104	9.99 938	56
5	8.73 069	234	8.73 132	234	1.26 868	9.99 937	55
6	8.73 303	234	8.73 366	234	1.26 634	9.99 936	54
7	8.73 535	232	8.73 600	234	1.26 400	9.99 936	53
8	8.73 767	232	8.73 832	232	1.26 168	9.99 935	52
9	8.73 997	230	8.74 063	231	1.25 937	9.99 934	51
10	8.74 226	229	8.74 292	229	1.25 708	9.99 934	50
11	8.74 454	228	8.74 521	229	1.25 479	9.99 933	49
12	8.74 680	226	8.74 748	227	1.25 252	9.99 932	48
13	8.74 906	226	8.74 974	226	1.25 026	9.99 932	47
14	8.75 130	224	8.75 199	225	1.24 801	9.99 931	46
15	8.75 353	223	8.75 423	224	1.24 577	9.99 930	45
16	8.75 575	222	8.75 645	222	1.24 355	9.99 929	44
17	8.75 795	220	8.75 867	222	1.24 133	9.99 929	43
18	8.76 015	220	8.76 087	220	1.23 913	9.99 928	42
19	8.76 234	219	8.76 306	219	1.23 694	9.99 927	41
20	8.76 451	217	8.76 525	219	1.23 475	9.99 926	40
21	8.76 667	216	8.76 742	217	1.23 258	9.99 926	39
22	8.76 883	216	8.76 958	216	1.23 042	9.99 925	38
23	8.77 097	214	8.77 173	215	1.22 827	9.99 924	37
24	8.77 310	213	8.77 387	214	1.22 613	9.99 923	36
25	8.77 522	212	8.77 600	213	1.22 400	9.99 923	35
26	8.77 733	211	8.77 811	211	1.22 189	9.99 922	34
27	8.77 943	210	8.78 022	211	1.21 978	9.99 921	33
28	8.78 152	209	8.78 232	210	1.21 768	9.99 920	32
29	8.78 360	208	8.78 441	209	1.21 559	9.99 920	31
30	8.78 568	208	8.78 649	208	1.21 351	9.99 919	30
31	8.78 774	206	8.78 855	206	1.21 145	9.99 918	29
32	8.78 979	205	8.79 061	206	1.20 939	9.99 917	28
33	8.79 183	204	8.79 266	205	1.20 734	9.99 917	27
34	8.79 386	203	8.79 470	204	1.20 530	9.99 916	26
35	8.79 588	202	8.79 673	203	1.20 327	9.99 915	25
36	8.79 789	201	8.79 875	202	1.20 125	9.99 914	24
37	8.79 990	201	8.80 076	201	1.19 924	9.99 913	23
38	8.80 189	199	8.80 277	201	1.19 723	9.99 913	22
39	8.80 388	199	8.80 476	199	1.19 524	9.99 912	21
40	8.80 585	197	8.80 674	198	1.19 326	9.99 911	20
41	8.80 782	197	8.80 872	198	1.19 128	9.99 910	19
42	8.80 978	196	8.81 068	196	1.18 932	9.99 909	18
43	8.81 173	195	8.81 264	196	1.18 736	9.99 909	17
44	8.81 367	194	8.81 459	195	1.18 541	9.99 908	16
45	8.81 560	193	8.81 653	194	1.18 347	9.99 907	15
46	8.81 752	192	8.81 846	193	1.18 154	9.99 906	14
47	8.81 944	192	8.82 038	192	1.17 962	9.99 905	13
48	8.82 134	190	8.82 230	192	1.17 770	9.99 904	12
49	8.82 324	190	8.82 420	190	1.17 580	9.99 904	11
50	8.82 513	189	8.82 610	190	1.17 390	9.99 903	10
51	8.82 701	188	8.82 799	189	1.17 201	9.99 902	9
52	8.82 888	187	8.82 987	188	1.17 013	9.99 901	8
53	8.83 075	187	8.83 175	188	1.16 825	9.99 900	7
54	8.83 261	186	8.83 361	186	1.16 639	9.99 899	6
55	8.83 446	185	8.83 547	186	1.16 453	9.99 898	5
56	8.83 630	184	8.83 732	185	1.16 268	9.99 898	4
57	8.83 813	183	8.83 916	184	1.16 084	9.99 897	3
58	8.83 996	183	8.84 100	184	1.15 900	9.99 896	2
59	8.84 177	181	8.84 282	182	1.15 718	9.99 895	1
60	8.84 358	181	8.84 464	182	1.15 536	9.99 894	0
′	L. Cos.	d.	L. Cot.	c.d.	L. Tan.	L. Sin.	′

″	P. P.				
	241	239	237	235	234
1	4.0	4.0	4.0	3.9	3.9
2	8.0	8.0	7.9	7.8	7.8
3	12.0	12.0	11.8	11.8	11.7
4	16.1	15.9	15.8	15.7	15.6
5	20.1	19.9	19.8	19.6	19.5
6	24.1	23.9	23.7	23.5	23.4
7	28.1	27.9	27.6	27.4	27.3
8	32.1	31.9	31.6	31.3	31.2
9	36.2	35.8	35.6	35.2	35.1
″	232	229	227	225	223
1	3.9	3.8	3.8	3.8	3.7
2	7.7	7.6	7.6	7.5	7.4
3	11.6	11.4	11.4	11.2	11.2
4	15.5	15.3	15.1	15.0	14.9
5	19.3	19.1	18.9	18.8	18.6
6	23.2	22.9	22.7	22.5	22.3
7	27.1	26.7	26.5	26.2	26.0
8	30.9	30.5	30.3	30.0	29.7
9	34.8	34.4	34.0	33.8	33.4
″	222	220	217	215	213
1	3.7	3.7	3.6	3.6	3.6
2	7.4	7.3	7.2	7.2	7.1
3	11.1	11.0	10.8	10.8	10.6
4	14.8	14.7	14.5	14.3	14.2
5	18.5	18.3	18.1	17.9	17.8
6	22.2	22.0	21.7	21.5	21.3
7	25.9	25.7	25.3	25.1	24.8
8	29.6	29.3	28.9	28.7	28.4
9	33.3	33.0	32.6	32.2	32.0
″	211	208	206	203	201
1	3.5	3.5	3.4	3.4	3.4
2	7.0	6.9	6.9	6.8	6.7
3	10.6	10.4	10.3	10.2	10.0
4	14.1	13.9	13.7	13.5	13.4
5	17.6	17.3	17.2	16.9	16.8
6	21.1	20.8	20.6	20.3	20.1
7	24.6	24.3	24.0	23.7	23.4
8	28.1	27.7	27.5	27.1	26.8
9	31.6	31.2	30.9	30.4	30.2
″	199	197	195	193	192
1	3.3	3.3	3.2	3.2	3.2
2	6.6	6.6	6.5	6.4	6.4
3	10.0	9.8	9.8	9.6	9.6
4	13.3	13.1	13.0	12.9	12.8
5	16.6	16.4	16.2	16.1	16.0
6	19.9	19.7	19.5	19.3	19.2
7	23.2	23.0	22.8	22.5	22.4
8	26.5	26.3	26.0	25.7	25.6
9	29.8	29.6	29.2	29.0	28.8
″	189	187	185	183	181
1	3.2	3.1	3.1	3.0	3.0
2	6.3	6.2	6.2	6.1	6.0
3	9.4	9.4	9.2	9.2	9.0
4	12.6	12.5	12.3	12.2	12.1
5	15.8	15.6	15.4	15.2	15.1
6	18.9	18.7	18.5	18.3	18.1
7	22.0	21.8	21.6	21.4	21.1
8	25.2	24.9	24.7	24.4	24.1
9	28.4	28.0	27.8	27.4	27.2
10	31.5	31.2	30.8	30.5	30.2

′	P. P.

93° (273°) (266°) 86°

4° (184°) (355°) **175°**

′	L. Sin.	d.	L. Tan.	c.d.	L. Cot.	L. Cos.	′
0	8.84 358		8.84 464		1.15 536	9.99 894	**60**
1	8.84 539	181	8.84 646	182	1.15 354	9.99 893	59
2	8.84 718	179	8.84 826	180	1.15 174	9.99 892	58
3	8.84 897	179	8.85 006	180	1.14 994	9.99 891	57
4	8.85 075	178	8.85 185	179	1.14 815	9.99 891	56
5	8.85 252	177	8.85 363	178	1.14 637	9.99 890	55
6	8.85 429	177	8.85 540	177	1.14 460	9.99 889	54
7	8.85 605	176	8.85 717	177	1.14 283	9.99 888	53
8	8.85 780	175	8.85 893	176	1.14 107	9.99 887	52
9	8.85 955	175	8.86 069	176	1.13 931	9.99 886	51
10	8.86 128	173	8.86 243	174	1.13 757	9.99 885	**50**
11	8.86 301	173	8.86 417	174	1.13 583	9.99 884	49
12	8.86 474	173	8.86 591	174	1.13 409	9.99 883	48
13	8.86 645	171	8.86 763	172	1.13 237	9.99 882	47
14	8.86 816	171	8.86 935	172	1.13 065	9.99 881	46
15	8.86 987	171	8.87 106	171	1.12 894	9.99 880	45
16	8.87 156	169	8.87 277	171	1.12 723	9.99 879	44
17	8.87 325	169	8.87 447	170	1.12 553	9.99 879	43
18	8.87 494	169	8.87 616	169	1.12 384	9.99 878	42
19	8.87 661	167	8.87 785	169	1.12 215	9.99 877	41
20	8.87 829	168	8.87 953	168	1.12 047	9.99 876	**40**
21	8.87 995	166	8.88 120	167	1.11 880	9.99 875	39
22	8.88 161	166	8.88 287	167	1.11 713	9.99 874	38
23	8.88 326	165	8.88 453	166	1.11 547	9.99 873	37
24	8.88 490	164	8.88 618	165	1.11 382	9.99 872	36
25	8.88 654	164	8.88 783	165	1.11 217	9.99 871	35
26	8.88 817	163	8.88 948	165	1.11 052	9.99 870	34
27	8.88 980	163	8.89 111	163	1.10 889	9.99 869	33
28	8.89 142	162	8.89 274	163	1.10 726	9.99 868	32
29	8.89 304	162	8.89 437	163	1.10 563	9.99 867	31
30	8.89 464	160	8.89 598	161	1.10 402	9.99 866	**30**
31	8.89 625	161	8.89 760	162	1.10 240	9.99 865	29
32	8.89 784	159	8.89 920	160	1.10 080	9.99 864	28
33	8.89 943	159	8.90 080	160	1.09 920	9.99 863	27
34	8.90 102	159	8.90 240	160	1.09 760	9.99 862	26
35	8.90 260	158	8.90 399	159	1.09 601	9.99 861	25
36	8.90 417	157	8.90 557	158	1.09 443	9.99 860	24
37	8.90 574	157	8.90 715	158	1.09 285	9.99 859	23
38	8.90 730	156	8.90 872	157	1.09 128	9.99 858	22
39	8.90 885	155	8.91 029	157	1.08 971	9.99 857	21
40	8.91 040	155	8.91 185	156	1.08 815	9.99 856	**20**
41	8.91 195	155	8.91 340	155	1.08 660	9.99 855	19
42	8.91 349	154	8.91 495	155	1.08 505	9.99 854	18
43	8.91 502	153	8.91 650	155	1.08 350	9.99 853	17
44	8.91 655	153	8.91 803	153	1.08 197	9.99 852	16
45	8.91 807	152	8.91 957	154	1.08 043	9.99 851	15
46	8.91 959	152	8.92 110	153	1.07 890	9.99 850	14
47	8.92 110	151	8.92 262	152	1.07 738	9.99 848	13
48	8.92 261	151	8.92 414	152	1.07 586	9.99 847	12
49	8.92 411	150	8.92 565	151	1.07 435	9.99 846	11
50	8.92 561	150	8.92 716	151	1.07 284	9.99 845	**10**
51	8.92 710	149	8.92 866	150	1.07 134	9.99 844	9
52	8.92 859	149	8.93 016	150	1.06 984	9.99 843	8
53	8.93 007	148	8.93 165	149	1.06 835	9.99 842	7
54	8.93 154	147	8.93 313	148	1.06 687	9.99 841	6
55	8.93 301	147	8.93 462	149	1.06 538	9.99 840	5
56	8.93 448	147	8.93 609	147	1.06 391	9.99 839	4
57	8.93 594	146	8.93 756	147	1.06 244	9.99 838	3
58	8.93 740	146	8.93 903	147	1.06 097	9.99 837	2
59	8.93 885	145	8.94 049	146	1.05 951	9.99 836	1
60	8.94 030	145	8.94 195	146	1.05 805	9.99 834	**0**
′	L. Cos.	d.	L. Cot.	c.d.	L. Tan.	L. Sin.	′

″	P.P.				
″	**182**	**181**	**179**	**178**	**177**
1	3.0	3.0	3.0	3.0	3.0
2	6.1	6.0	6.0	5.9	5.9
3	9.1	9.0	9.0	8.9	8.8
4	12.1	12.1	11.9	11.9	11.8
5	15.2	15.1	14.9	14.8	14.8
6	18.2	18.1	17.9	17.8	17.7
7	21.2	21.1	20.9	20.8	20.6
8	24.3	24.1	23.9	23.7	23.6
9	27.3	27.2	26.8	26.7	26.6
″	**176**	**175**	**174**	**173**	**172**
1	2.9	2.9	2.9	2.9	2.9
2	5.9	5.8	5.8	5.8	5.7
3	8.8	8.8	8.7	8.6	8.6
4	11.7	11.7	11.6	11.5	11.5
5	14.7	14.6	14.5	14.4	14.3
6	17.6	17.5	17.4	17.3	17.2
7	20.5	20.4	20.3	20.2	20.1
8	23.5	23.3	23.2	23.1	22.9
9	26.4	26.2	26.1	26.0	25.8
″	**171**	**170**	**169**	**168**	**167**
1	2.8	2.8	2.8	2.8	2.8
2	5.7	5.7	5.6	5.6	5.6
3	8.6	8.5	8.4	8.4	8.4
4	11.4	11.3	11.3	11.2	11.1
5	14.2	14.2	14.1	14.0	13.9
6	17.1	17.0	16.9	16.8	16.7
7	20.0	19.8	19.7	19.6	19.5
8	22.8	22.7	22.5	22.4	22.3
9	25.6	25.5	25.4	25.2	25.0
″	**166**	**165**	**164**	**163**	**162**
1	2.8	2.8	2.7	2.7	2.7
2	5.5	5.5	5.5	5.4	5.4
3	8.3	8.3	8.2	8.2	8.1
4	11.1	11.0	10.9	10.9	10.8
5	13.8	13.8	13.7	13.6	13.5
6	16.6	16.5	16.4	16.3	16.2
7	19.4	19.2	19.1	19.0	18.9
8	22.1	22.0	21.9	21.7	21.6
9	24.9	24.8	24.6	24.4	24.3
″	**161**	**160**	**159**	**158**	**157**
1	2.7	2.7	2.6	2.6	2.6
2	5.4	5.3	5.3	5.3	5.2
3	8.0	8.0	8.0	7.9	7.8
4	10.7	10.7	10.6	10.5	10.5
5	13.4	13.3	13.2	13.2	13.1
6	16.1	16.0	15.9	15.8	15.7
7	18.8	18.7	18.6	18.4	18.3
8	21.5	21.3	21.2	21.1	20.9
9	24.2	24.0	23.8	23.7	23.6
″	**156**	**155**	**154**	**153**	**152**
1	2.6	2.6	2.6	2.6	2.5
2	5.2	5.2	5.1	5.1	5.1
3	7.8	7.8	7.7	7.6	7.6
4	10.4	10.3	10.3	10.2	10.1
5	13.0	12.9	12.8	12.8	12.7
6	15.6	15.5	15.4	15.3	15.2
7	18.2	18.1	18.0	17.8	17.7
8	20.8	20.7	20.5	20.4	20.3
9	23.4	23.2	23.1	23.0	22.8
10	26.0	25.8	25.7	25.5	25.3

P.P.

94° (274°) (265°) **85°**

5° (185°) (354°) 174°

′	L. Sin.	d.	L.Tan.	c.d.	L. Cot.	L. Cos.	′
0	8.94 030		8.94 195		1.05 805	9.99 834	60
1	8.94 174	144	8.94 340	145	1.05 660	9.99 833	59
2	8.94 317	143	8.94 485	145	1.05 515	9.99 832	58
3	8.94 461	144	8.94 630	145	1.05 370	9.99 831	57
4	8.94 603	142	8.94 773	143	1.05 227	9.99 830	56
5	8.94 746	143	8.94 917	144	1.05 083	9.99 829	55
6	8.94 887	141	8.95 060	143	1.04 940	9.99 828	54
7	8.95 029	142	8.95 202	142	1.04 798	9.99 827	53
8	8.95 170	141	8.95 344	142	1.04 656	9.99 825	52
9	8.95 310	140	8.95 486	142	1.04 514	9.99 824	51
10	8.95 450		8.95 627	141	1.04 373	9.99 823	50
11	8.95 589	139	8.95 767	140	1.04 233	9.99 822	49
12	8.95 728	139	8.95 908	141	1.04 092	9.99 821	48
13	8.95 867	139	8.96 047	139	1.03 953	9.99 820	47
14	8.96 005	138	8.96 187	140	1.03 813	9.99 819	46
15	8.96 143	138	8.96 325	138	1.03 675	9.99 817	45
16	8.96 280	137	8.96 464	139	1.03 536	9.99 816	44
17	8.96 417	137	8.96 602	138	1.03 398	9.99 815	43
18	8.96 553	136	8.96 739	137	1.03 261	9.99 814	42
19	8.96 689	136	8.96 877	138	1.03 123	9.99 813	41
20	8.96 825	136	8.97 013	136	1.02 987	9.99 812	40
21	8.96 960	135	8.97 150	137	1.02 850	9.99 810	39
22	8.97 095	135	8.97 285	135	1.02 715	9.99 809	38
23	8.97 229	134	8.97 421	136	1.02 579	9.99 808	37
24	8.97 363	134	8.97 556	135	1.02 444	9.99 807	36
25	8.97 496	133	8.97 691	135	1.02 309	9.99 806	35
26	8.97 629	133	8.97 825	134	1.02 175	9.99 804	34
27	8.97 762	133	8.97 959	134	1.02 041	9.99 803	33
28	8.97 894	132	8.98 092	133	1.01 908	9.99 802	32
29	8.98 026	132	8.98 225	133	1.01 775	9.99 801	31
30	8.98 157	131	8.98 358	133	1.01 642	9.99 800	30
31	8.98 288	131	8.98 490	132	1.01 510	9.99 798	29
32	8.98 419	131	8.98 622	132	1.01 378	9.99 797	28
33	8.98 549	130	8.98 753	131	1.01 247	9.99 796	27
34	8.98 679	130	8.98 884	131	1.01 116	9.99 795	26
35	8.98 808	129	8.99 015	131	1.00 985	9.99 793	25
36	8.98 937	129	8.99 145	130	1.00 855	9.99 792	24
37	8.99 066	129	8.99 275	130	1.00 725	9.99 791	23
38	8.99 194	128	8.99 405	130	1.00 595	9.99 790	22
39	8.99 322	128	8.99 534	129	1.00 466	9.99 788	21
40	8.99 450	128	8.99 662	128	1.00 338	9.99 787	20
41	8.99 577	127	8.99 791	129	1.00 209	9.99 786	19
42	8.99 704	127	8.99 919	128	1.00 081	9.99 785	18
43	8.99 830	126	9.00 046	127	0.99 954	9.99 783	17
44	8.99 956	126	9.00 174	128	0.99 826	9.99 782	16
45	9.00 082	126	9.00 301	127	0.99 699	9.99 781	15
46	9.00 207	125	9.00 427	126	0.99 573	9.99 780	14
47	9.00 332	125	9.00 553	126	0.99 447	9.99 778	13
48	9.00 456	124	9.00 679	126	0.99 321	9.99 777	12
49	9.00 581	125	9.00 805	126	0.99 195	9.99 776	11
50	9.00 704	123	9.00 930	125	0.99 070	9.99 775	10
51	9.00 828	124	9.01 055	125	0.98 945	9.99 773	9
52	9.00 951	123	9.01 179	124	0.98 821	9.99 772	8
53	9.01 074	123	9.01 303	124	0.98 697	9.99 771	7
54	9.01 196	122	9.01 427	124	0.98 573	9.99 769	6
55	9.01 318	122	9.01 550	123	0.98 450	9.99 768	5
56	9.01 440	122	9.01 673	123	0.98 327	9.99 767	4
57	9.01 561	121	9.01 796	123	0.98 204	9.99 765	3
58	9.01 682	121	9.01 918	122	0.98 082	9.99 764	2
59	9.01 803	121	9.02 040	122	0.97 960	9.99 763	1
60	9.01 923	120	9.02 162	122	0.97 838	9.99 761	0
′	L. Cos.	d.	L. Cot.	c.d.	L. Tan.	L. Sin.	′

P.P.					
″	**151**	**149**	**148**	**147**	**146**
1	2.5	2.5	2.5	2.4	2.4
2	5.0	5.0	4.9	4.9	4.9
3	7.6	7.4	7.4	7.4	7.3
4	10.1	9.9	9.9	9.8	9.7
5	12.6	12.4	12.3	12.2	12.2
6	15.1	14.9	14.8	14.7	14.6
7	17.6	17.4	17.3	17.2	17.0
8	20.1	19.9	19.7	19.6	19.5
9	22.6	22.4	22.2	22.0	21.9
″	**145**	**144**	**143**	**142**	**141**
1	2.4	2.4	2.4	2.4	2.4
2	4.8	4.8	4.8	4.7	4.7
3	7.2	7.2	7.2	7.1	7.0
4	9.7	9.6	9.5	9.5	9.4
5	12.1	12.0	11.9	11.8	11.8
6	14.5	14.4	14.3	14.2	14.1
7	16.9	16.8	16.7	16.6	16.4
8	19.3	19.2	19.1	18.9	18.8
9	21.8	21.6	21.4	21.3	21.2
″	**140**	**139**	**138**	**137**	**136**
1	2.3	2.3	2.3	2.3	2.3
2	4.7	4.6	4.6	4.6	4.5
3	7.0	7.0	6.9	6.8	6.8
4	9.3	9.3	9.2	9.1	9.1
5	11.7	11.6	11.5	11.4	11.3
6	14.0	13.9	13.8	13.7	13.6
7	16.3	16.2	16.1	16.0	15.9
8	18.7	18.5	18.4	18.3	18.1
9	21.0	20.8	20.7	20.6	20.4
″	**135**	**134**	**133**	**132**	**131**
1	2.2	2.2	2.2	2.2	2.2
2	4.5	4.5	4.4	4.4	4.4
3	6.8	6.7	6.6	6.6	6.6
4	9.0	8.9	8.9	8.8	8.7
5	11.2	11.2	11.1	11.0	10.9
6	13.5	13.4	13.3	13.2	13.1
7	15.8	15.6	15.5	15.4	15.3
8	18.0	17.9	17.7	17.6	17.5
9	20.2	20.1	20.0	19.8	19.6
″	**130**	**129**	**128**	**127**	**126**
1	2.2	2.2	2.1	2.1	2.1
2	4.3	4.3	4.3	4.2	4.2
3	6.5	6.4	6.4	6.4	6.3
4	8.7	8.6	8.5	8.5	8.4
5	10.8	10.8	10.7	10.6	10.5
6	13.0	12.9	12.8	12.7	12.6
7	15.2	15.0	14.9	14.8	14.7
8	17.3	17.2	17.1	16.9	16.8
9	19.5	19.4	19.2	19.0	18.9
″	**125**	**124**	**123**	**122**	**121**
1	2.1	2.1	2.0	2.0	2.0
2	4.2	4.1	4.1	4.1	4.0
3	6.2	6.2	6.2	6.1	6.0
4	8.3	8.3	8.2	8.1	8.1
5	10.4	10.3	10.2	10.2	10.1
6	12.5	12.4	12.3	12.2	12.1
7	14.6	14.5	14.4	14.2	14.1
8	16.7	16.5	16.4	16.3	16.1
9	18.8	18.6	18.4	18.3	18.2
10	20.8	20.7	20.5	20.3	20.2

P.P.

85° (275°) (264°) 84°

6° (186°) (353°) **173°**

′	L. Sin.	d.	L. Tan.	c.d.	L. Cot.	L. Cos.	′	P. P.			
0	9.01 923		9.02 162		0.97 838	9.99 761	**60**	″	**121**	**120**	**119**	**118**
1	9.02 043	120	9.02 283	121	0.97 717	9.99 760	59	1	2.0	2.0	2.0	2.0
2	9.02 163	120	9.02 404	121	0.97 596	9.99 759	58	2	4.0	4.0	4.0	3.9
3	9.02 283	120	9.02 525	121	0.97 475	9.99 757	57	3	6.0	6.0	6.0	5.9
4	9.02 402	119	9.02 645	120	0.97 355	9.99 756	56	4	8.1	8.0	7.9	7.9
5	9.02 520	118	9.02 766	121	0.97 234	9.99 755	55	5	10.1	10.0	9.9	9.8
6	9.02 639	119	9.02 885	119	0.97 115	9.99 753	54	6	12.1	12.0	11.9	11.8
7	9.02 757	118	9.03 005	120	0.96 995	9.99 752	53	7	14.1	14.0	13.9	13.8
8	9.02 874	117	9.03 124	119	0.96 876	9.99 751	52	8	16.1	16.0	15.9	15.7
9	9.02 992	118	9.03 242	118	0.96 758	9.99 749	51	9	18.2	18.0	17.8	17.7
10	9.03 109	117	9.03 361	119	0.96 639	9.99 748	**50**	10	20.2	20.0	19.8	19.7
11	9.03 226	117	9.03 479	118	0.96 521	9.99 747	49	20	40.3	40.0	39.7	39.3
12	9.03 342	116	9.03 597	118	0.96 403	9.99 745	48	30	60.5	60.0	59.5	59.0
13	9.03 458	116	9.03 714	117	0.96 286	9.99 744	47	40	80.7	80.0	79.3	78.7
14	9.03 574	116	9.03 832	118	0.96 168	9.99 742	46	50	100.8	100.0	99.2	98.3
15	9.03 690	116	9.03 948	116	0.96 052	9.99 741	45	″	**117**	**116**	**115**	**114**
16	9.03 805	115	9.04 065	117	0.95 935	9.99 740	44	1	2.0	1.9	1.9	1.9
17	9.03 920	115	9.04 181	116	0.95 819	9.99 738	43	2	3.9	3.9	3.8	3.8
18	9.04 034	114	9.04 297	116	0.95 703	9.99 737	42	3	5.8	5.8	5.8	5.7
19	9.04 149	115	9.04 413	116	0.95 587	9.99 736	41	4	7.8	7.7	7.7	7.6
20	9.04 262	113	9.04 528	115	0.95 472	9.99 734	**40**	5	9.8	9.7	9.6	9.5
21	9.04 376	114	9.04 643	115	0.95 357	9.99 733	39	6	11.7	11.6	11.5	11.4
22	9.04 490	114	9.04 758	115	0.95 242	9.99 731	38	7	13.6	13.5	13.4	13.3
23	9.04 603	113	9.04 873	114	0.95 127	9.99 730	37	8	15.6	15.5	15.3	15.2
24	9.04 715	112	9.04 987	114	0.95 013	9.99 728	36	9	17.6	17.4	17.2	17.1
25	9.04 828	113	9.05 101	114	0.94 899	9.99 727	35	10	19.5	19.3	19.2	19.0
26	9.04 940	112	9.05 214	113	0.94 786	9.99 726	34	20	39.0	38.7	38.3	38.0
27	9.05 052	112	9.05 328	114	0.94 672	9.99 724	33	30	58.5	58.0	57.5	57.0
28	9.05 164	112	9.05 441	113	0.94 559	9.99 723	32	40	78.0	77.3	76.7	76.0
29	9.05 275	111	9.05 553	112	0.94 447	9.99 721	31	50	97.5	96.7	95.8	95.0
30	9.05 386	111	9.05 666	113	0.94 334	9.99 720	**30**	″	**113**	**112**	**111**	**110**
31	9.05 497	111	9.05 778	112	0.94 222	9.99 718	29	1	1.9	1.9	1.8	1.8
32	9.05 607	110	9.05 890	112	0.94 110	9.99 717	28	2	3.8	3.7	3.7	3.7
33	9.05 717	110	9.06 002	112	0.93 998	9.99 716	27	3	5.6	5.6	5.6	5.5
34	9.05 827	110	9.06 113	111	0.93 887	9.99 714	26	4	7.5	7.5	7.4	7.3
35	9.05 937	110	9.06 224	111	0.93 776	9.99 713	25	5	9.4	9.3	9.2	9.2
36	9.06 046	109	9.06 335	111	0.93 665	9.99 711	24	6	11.3	11.2	11.1	11.0
37	9.06 155	109	9.06 445	110	0.93 555	9.99 710	23	7	13.2	13.1	13.0	12.8
38	9.06 264	109	9.06 556	111	0.93 444	9.99 708	22	8	15.1	14.9	14.8	14.7
39	9.06 372	108	9.06 666	110	0.93 334	9.99 707	21	9	17.0	16.8	16.6	16.5
40	9.06 481	109	9.06 775	109	0.93 225	9.99 705	**20**	10	18.8	18.7	18.5	18.3
41	9.06 589	108	9.06 885	110	0.93 115	9.99 704	19	20	37.7	37.3	37.0	36.7
42	9.06 696	107	9.06 994	109	0.93 006	9.99 702	18	30	56.5	56.0	55.5	55.0
43	9.06 804	108	9.07 103	109	0.92 897	9.99 701	17	40	75.3	74.7	74.0	73.3
44	9.06 911	107	9.07 211	108	0.92 789	9.99 699	16	50	94.2	93.3	92.5	91.7
45	9.07 018	107	9.07 320	107	0.92 680	9.99 698	15	″	**109**	**108**	**107**	**106**
46	9.07 124	106	9.07 428	108	0.92 572	9.99 696	14	1	1.8	1.8	1.8	1.8
47	9.07 231	107	9.07 536	108	0.92 464	9.99 695	13	2	3.6	3.6	3.6	3.5
48	9.07 337	106	9.07 643	107	0.92 357	9.99 693	12	3	5.4	5.4	5.4	5.3
49	9.07 442	105	9.07 751	108	0.92 249	9.99 692	11	4	7.3	7.2	7.1	7.1
50	9.07 548	106	9.07 858	107	0.92 142	9.99 690	**10**	5	9.1	9.0	8.9	8.8
51	9.07 653	105	9.07 964	106	0.92 036	9.99 689	9	6	10.9	10.8	10.7	10.6
52	9.07 758	105	9.08 071	107	0.91 929	9.99 687	8	7	12.7	12.6	12.5	12.4
53	9.07 863	105	9.08 177	106	0.91 823	9.99 686	7	8	14.5	14.4	14.3	14.1
54	9.07 968	105	9.08 283	106	0.91 717	9.99 684	6	9	16.4	16.2	16.0	15.9
55	9.08 072	104	9.08 389	106	0.91 611	9.99 683	5	10	18.2	18.0	17.8	17.7
56	9.08 176	104	9.08 495	105	0.91 505	9.99 681	4	20	36.3	36.0	35.7	35.3
57	9.08 280	104	9.08 600	105	0.91 400	9.99 680	3	30	54.5	54.0	53.5	53.0
58	9.08 383	103	9.08 705	105	0.91 295	9.99 678	2	40	72.7	72.0	71.3	70.6
59	9.08 486	103	9.08 810	105	0.91 190	9.99 677	1	50	90.8	90.0	89.2	88.4
60	9.08 589		9.08 914	104	0.91 086	9.99 675	**0**					
′	L. Cos.	d.	L. Cot.	c.d.	L. Tan.	L. Sin.	′	P. P.				

96° (276°) (263°) **83°**

7° (187°) (352°) **172°**

′	L. Sin.	d.	L. Tan.	c.d.	L. Cot.	L. Cos.	′
0	9.08 589		9.08 914		0.91 086	9.99 675	**60**
1	9.08 692	103	9.09 019	105	0.90 981	9.99 674	59
2	9.08 795	103	9.09 123	104	0.90 877	9.99 672	58
3	9.08 897	102	9.09 227	104	0.90 773	9.99 670	57
4	9.08 999	102	9.09 330	103	0.90 670	9.99 669	56
5	9.09 101	102	9.09 434	104	0.90 566	9.99 667	55
6	9.09 202	101	9.09 537	103	0.90 463	9.99 666	54
7	9.09 304	102	9.09 640	103	0.90 360	9.99 664	53
8	9.09 405	101	9.09 742	102	0.90 258	9.99 663	52
9	9.09 506	101	9.09 845	103	0.90 155	9.99 661	51
10	9.09 606	100	9.09 947	102	0.90 053	9.99 659	**50**
11	9.09 707	101	9.10 049	102	0.89 951	9.99 658	49
12	9.09 807	100	9.10 150	101	0.89 850	9.99 656	48
13	9.09 907	100	9.10 252	102	0.89 748	9.99 655	47
14	9.10 006	99	9.10 353	101	0.89 647	9.99 653	46
15	9.10 106	100	9.10 454	101	0.89 546	9.99 651	45
16	9.10 205	99	9.10 555	101	0.89 445	9.99 650	44
17	9.10 304	99	9.10 656	100	0.89 344	9.99 648	43
18	9.10 402	98	9.10 756	100	0.89 244	9.99 647	42
19	9.10 501	99	9.10 856	100	0.89 144	9.99 645	41
20	9.10 599	98	9.10 956	100	0.89 044	9.99 643	**40**
21	9.10 697	98	9.11 056	100	0.88 944	9.99 642	39
22	9.10 795	98	9.11 155	99	0.88 845	9.99 640	38
23	9.10 893	98	9.11 254	99	0.88 746	9.99 638	37
24	9.10 990	97	9.11 353	99	0.88 647	9.99 637	36
25	9.11 087	97	9.11 452	99	0.88 548	9.99 635	35
26	9.11 184	97	9.11 551	99	0.88 449	9.99 633	34
27	9.11 281	96	9.11 649	98	0.88 351	9.99 632	33
28	9.11 377	97	9.11 747	98	0.88 253	9.99 630	32
29	9.11 474	96	9.11 845	98	0.88 155	9.99 629	31
30	9.11 570	96	9.11 943	98	0.88 057	9.99 627	**30**
31	9.11 666	95	9.12 040	97	0.87 960	9.99 625	29
32	9.11 761	96	9.12 138	98	0.87 862	9.99 624	28
33	9.11 857	95	9.12 235	97	0.87 765	9.99 622	27
34	9.11 952	95	9.12 332	97	0.87 668	9.99 620	26
35	9.12 047	95	9.12 428	96	0.87 572	9.99 618	25
36	9.12 142	94	9.12 525	97	0.87 475	9.99 617	24
37	9.12 236	95	9.12 621	96	0.87 379	9.99 615	23
38	9.12 331	94	9.12 717	96	0.87 283	9.99 613	22
39	9.12 425	94	9.12 813	96	0.87 187	9.99 612	21
40	9.12 519	93	9.12 909	96	0.87 091	9.99 610	**20**
41	9.12 612	94	9.13 004	95	0.86 996	9.99 608	19
42	9.12 706	93	9.13 099	95	0.86 901	9.99 607	18
43	9.12 799	93	9.13 194	95	0.86 806	9.99 605	17
44	9.12 892	93	9.13 289	95	0.86 711	9.99 603	16
45	9.12 985	93	9.13 384	95	0.86 616	9.99 601	15
46	9.13 078	93	9.13 478	94	0.86 522	9.99 600	14
47	9.13 171	93	9.13 573	95	0.86 427	9.99 598	13
48	9.13 263	92	9.13 667	94	0.86 333	9.99 596	12
49	9.13 355	92	9.13 761	94	0.86 239	9.99 595	11
50	9.13 447	92	9.13 854	93	0.86 146	9.99 593	**10**
51	9.13 539	91	9.13 948	94	0.86 052	9.99 591	9
52	9.13 630	92	9.14 041	93	0.85 959	9.99 589	8
53	9.13 722	91	9.14 134	93	0.85 866	9.99 588	7
54	9.13 813	91	9.14 227	93	0.85 773	9.99 586	6
55	9.13 904	90	9.14 320	92	0.85 680	9.99 584	5
56	9.13 994	91	9.14 412	92	0.85 588	9.99 582	4
57	9.14 085	90	9.14 504	92	0.85 496	9.99 581	3
58	9.14 175	91	9.14 597	93	0.85 403	9.99 579	2
59	9.14 266	90	9.14 688	91	0.85 312	9.99 577	1
60	9.14 356		9.14 780	92	0.85 220	9.99 575	**0**
′	L. Cos.	d.	L. Cot.	c.d.	L. Tan.	L. Sin.	′

	P. P.			
″	**105**	**104**	**103**	**102**
1	1.8	1.7	1.7	1.7
2	3.5	3.5	3.4	3.4
3	5.2	5.2	5.2	5.1
4	7.0	6.9	6.9	6.8
5	8.8	8.7	8.6	8.5
6	10.5	10.4	10.3	10.2
7	12.2	12.1	12.0	11.9
8	14.0	13.9	13.7	13.6
9	15.8	15.6	15.4	15.3
10	17.5	17.3	17.2	17.0
20	35.0	34.7	34.3	34.0
30	52.5	52.0	51.5	51.0
40	70.0	69.3	68.7	68.0
50	87.5	86.7	85.8	85.0
″	**101**	**100**	**99**	**98**
1	1.7	1.7	1.6	1.6
2	3.4	3.3	3.3	3.3
3	5.0	5.0	5.0	4.9
4	6.7	6.7	6.6	6.5
5	8.4	8.3	8.2	8.2
6	10.1	10.0	9.9	9.8
7	11.8	11.7	11.6	11.4
8	13.5	13.3	13.2	13.1
9	15.2	15.0	14.8	14.7
10	16.8	16.7	16.5	16.3
20	33.7	33.3	33.0	32.7
30	50.5	50.0	49.5	49.0
40	67.3	66.7	66.0	65.3
50	84.2	83.3	82.5	81.7
″	**97**	**96**	**95**	**94**
1	1.6	1.6	1.6	1.6
2	3.2	3.2	3.2	3.1
3	4.8	4.8	4.8	4.7
4	6.5	6.4	6.3	6.3
5	8.1	8.0	7.9	7.8
6	9.7	9.6	9.5	9.4
7	11.3	11.2	11.1	11.0
8	12.9	12.8	12.7	12.5
9	14.6	14.4	14.2	14.1
10	16.2	16.0	15.8	15.7
20	32.3	32.0	31.7	31.3
30	48.5	48.0	47.5	47.0
40	64.7	64.0	63.3	62.7
50	80.8	80.0	79.2	78.3
″	**93**	**92**	**91**	**90**
1	1.6	1.5	1.5	1.5
2	3.1	3.1	3.0	3.0
3	4.6	4.6	4.6	4.5
4	6.2	6.1	6.1	6.0
5	7.8	7.7	7.6	7.5
6	9.3	9.2	9.1	9.0
7	10.8	10.7	10.6	10.5
8	12.4	12.3	12.1	12.0
9	14.0	13.8	13.6	13.5
10	15.5	15.3	15.2	15.0
20	31.0	30.7	30.3	30.0
30	46.5	46.0	45.5	45.0
40	62.0	61.3	60.7	60.0
50	77.5	76.7	75.8	75.0

P. P

97° (277°) (262°) **82°**

8° (188°) (351°) 171°

′	L. Sin.	d.	L. Tan.	c. d.	L. Cot.	L. Cos.	′	P. P.		
0	9.14 356		9.14 780		0.85 220	9.99 575	60	″	92	91	90
1	9.14 445	89	9.14 872	92	0.85 128	9.99 574	59	1	1.5	1.5	1.5
2	9.14 535	90	9.14 963	91	0.85 037	9.99 572	58	2	3.1	3.0	3.0
3	9.14 624	89	9.15 054	91	0.84 946	9.99 570	57	3	4.6	4.6	4.5
4	9.14 714	90	9.15 145	91	0.84 855	9.99 568	56	4	6.1	6.1	6.0
5	9.14 803	89	9.15 236	91	0.84 764	9.99 566	55	5	7.7	7.6	7.5
6	9.14 891	88	9.15 327	91	0.84 673	9.99 565	54	6	9.2	9.1	9.0
7	9.14 980	89	9.15 417	90	0.84 583	9.99 563	53	7	10.7	10.6	10.5
8	9.15 069	89	9.15 508	91	0.84 492	9.99 561	52	8	12.3	12.1	12.0
9	9.15 157	88	9.15 598	90	0.84 402	9.99 559	51	9	13.8	13.6	13.5
10	9.15 245	88	9.15 688	90	0.84 312	9.99 557	50	10	15.3	15.2	15.0
11	9.15 333	88	9.15 777	89	0.84 223	9.99 556	49	20	30.7	30.3	30.0
12	9.15 421	87	9.15 867	90	0.84 133	9.99 554	48	30	46.0	45.5	45.0
13	9.15 508	88	9.15 956	89	0.84 044	9.99 552	47	40	61.3	60.7	60.0
14	9.15 596	87	9.16 046	90	0.83 954	9.99 550	46	50	76.7	75.8	75.0
15	9.15 683	87	9.16 135	89	0.83 865	9.99 548	45	″	89	88	87
16	9.15 770	87	9.16 224	89	0.83 776	9.99 546	44	1	1.5	1.5	1.4
17	9.15 857	87	9.16 312	88	0.83 688	9.99 545	43	2	3.0	2.9	2.9
18	9.15 944	87	9.16 401	89	0.83 599	9.99 543	42	3	4.4	4.4	4.4
19	9.16 030	86	9.16 489	88	0.83 511	9.99 541	41	4	5.9	5.9	5.8
20	9.16 116	86	9.16 577	88	0.83 423	9.99 539	40	5	7.4	7.3	7.2
21	9.16 203	87	9.16 665	88	0.83 335	9.99 537	39	6	8.9	8.8	8.7
22	9.16 289	86	9.16 753	88	0.83 247	9.99 535	38	7	10.4	10.3	10.2
23	9.16 374	85	9.16 841	88	0.83 159	9.99 533	37	8	11.9	11.7	11.6
24	9.16 460	86	9.16 928	87	0.83 072	9.99 532	36	9	13.4	13.2	13.0
25	9.16 545	85	9.17 016	88	0.82 984	9.99 530	35	10	14.8	14.7	14.5
26	9.16 631	86	9.17 103	87	0.82 897	9.99 528	34	20	29.7	29.3	29.0
27	9.16 716	85	9.17 190	87	0.82 810	9.99 526	33	30	44.5	44.0	43.5
28	9.16 801	85	9.17 277	87	0.82 723	9.99 524	32	40	59.3	58.7	58.0
29	9.16 886	85	9.17 363	86	0.82 637	9.99 522	31	50	74.2	73.3	72.5
30	9.16 970	84	9.17 450	87	0.82 550	9.99 520	30	″	86	85	84
31	9.17 055	85	9.17 536	86	0.82 464	9.99 518	29	1	1.4	1.4	1.4
32	9.17 139	84	9.17 622	86	0.82 378	9.99 517	28	2	2.9	2.8	2.8
33	9.17 223	84	9.17 708	86	0.82 292	9.99 515	27	3	4.3	4.2	4.2
34	9.17 307	84	9.17 794	86	0.82 206	9.99 513	26	4	5.7	5.7	5.6
35	9.17 391	84	9.17 880	86	0.82 120	9.99 511	25	5	7.2	7.1	7.0
36	9.17 474	83	9.17 965	85	0.82 035	9.99 509	24	6	8.6	8.5	8.4
37	9.17 558	84	9.18 051	86	0.81 949	9.99 507	23	7	10.0	9.9	9.8
38	9.17 641	83	9.18 136	85	0.81 864	9.99 505	22	8	11.5	11.3	11.2
39	9.17 724	83	9.18 221	85	0.81 779	9.99 503	21	9	12.9	12.8	12.6
40	9.17 807	83	9.18 306	85	0.81 694	9.99 501	20	10	14.3	14.2	14.0
41	9.17 890	83	9.18 391	84	0.81 609	9.99 499	19	20	28.7	28.3	28.0
42	9.17 973	83	9.18 475	84	0.81 525	9.99 497	18	30	43.0	42.5	42.0
43	9.18 055	82	9.18 560	85	0.81 440	9.99 495	17	40	57.3	56.7	56.0
44	9.18 137	82	9.18 644	84	0.81 356	9.99 494	16	50	71.7	70.8	70.0
45	9.18 220	83	9.18 728	84	0.81 272	9.99 492	15	″	83	82	81
46	9.18 302	82	9.18 812	84	0.81 188	9.99 490	14	1	1.4	1.4	1.4
47	9.18 383	81	9.18 896	84	0.81 104	9.99 488	13	2	2.8	2.7	2.7
48	9.18 465	82	9.18 979	83	0.81 021	9.99 486	12	3	4.2	4.1	4.0
49	9.18 547	82	9.19 063	84	0.80 937	9.99 484	11	4	5.5	5.5	5.4
50	9.18 628	81	9.19 146	83	0.80 854	9.99 482	10	5	6.9	6.8	6.8
51	9.18 709	81	9.19 229	83	0.80 771	9.99 480	9	6	8.3	8.2	8.1
52	9.18 790	81	9.19 312	83	0.80 688	9.99 478	8	7	9.7	9.6	9.4
53	9.18 871	81	9.19 395	83	0.80 605	9.99 476	7	8	11.1	10.9	10.8
54	9.18 952	81	9.19 478	83	0.80 522	9.99 474	6	9	12.4	12.3	12.2
55	9.19 033	81	9.19 561	83	0.80 439	9.99 472	5	10	13.8	13.7	13.5
56	9.19 113	80	9.19 643	82	0.80 357	9.99 470	4	20	27.7	27.3	27.0
57	9.19 193	80	9.19 725	82	0.80 275	9.99 468	3	30	41.5	41.0	40.5
58	9.19 273	80	9.19 807	82	0.80 193	9.99 466	2	30	55.3	54.7	54.0
59	9.19 353	80	9.19 889	82	0.80 111	9.99 464	1	50	69.2	68.3	67.5
60	9.19 433	80	9.19 971	82	0.80 029	9.99 462	0				
′	L. Cos.	d.	L. Cot.	c. d.	L. Tan.	L. Sin.	′	P. P.			

98° (278°) (261°) 81°

9° (189°) (350°) 170°

′	L. Sin.	d.	L. Tan.	c.d.	L. Cot.	L. Cos.	′
0	9.19 433		9.19 971		0.80 029	9.99 462	60
1	9.19 513	80	9.20 053	82	0.79 947	9.99 460	59
2	9.19 592	79	9.20 134	81	0.79 866	9.99 458	58
3	9.19 672	80	9.20 216	82	0.79 784	9.99 456	57
4	9.19 751	79	9.20 297	81	0.79 703	9.99 454	56
5	9.19 830	79	9.20 378	81	0.79 622	9.99 452	55
6	9.19 909	79	9.20 459	81	0.79 541	9.99 450	54
7	9.19 988	79	9.20 540	81	0.79 460	9.99 448	53
8	9.20 067	78	9.20 621	81	0.79 379	9.99 446	52
9	9.20 145	78	9.20 701	80	0.79 299	9.99 444	51
10	9.20 223	78	9.20 782	81	0.79 218	9.99 442	50
11	9.20 302	79	9.20 862	80	0.79 138	9.99 440	49
12	9.20 380	78	9.20 942	80	0.79 058	9.99 438	48
13	9.20 458	78	9.21 022	80	0.78 978	9.99 436	47
14	9.20 535	78	9.21 102	80	0.78 898	9.99 434	46
15	9.20 613	78	9.21 182	80	0.78 818	9.99 432	45
16	9.20 691	78	9.21 261	79	0.78 739	9.99 429	44
17	9.20 768	77	9.21 341	80	0.78 659	9.99 427	43
18	9.20 845	77	9.21 420	79	0.78 580	9.99 425	42
19	9.20 922	77	9.21 499	79	0.78 501	9.99 423	41
20	9.20 999	77	9.21 578	79	0.78 422	9.99 421	40
21	9.21 076	77	9.21 657	79	0.78 343	9.99 419	39
22	9.21 153	77	9.21 736	79	0.78 264	9.99 417	38
23	9.21 229	76	9.21 814	78	0.78 186	9.99 415	37
24	9.21 306	77	9.21 893	79	0.78 107	9.99 413	36
25	9.21 382	76	9.21 971	78	0.78 029	9.99 411	35
26	9.21 458	76	9.22 049	78	0.77 951	9.99 409	34
27	9.21 534	76	9.22 127	78	0.77 873	9.99 407	33
28	9.21 610	76	9.22 205	78	0.77 795	9.99 404	32
29	9.21 685	75	9.22 283	78	0.77 717	9.99 402	31
30	9.21 761	76	9.22 361	78	0.77 639	9.99 400	30
31	9.21 836	75	9.22 438	77	0.77 562	9.99 398	29
32	9.21 912	76	9.22 516	78	0.77 484	9.99 396	28
33	9.21 987	75	9.22 593	77	0.77 407	9.99 394	27
34	9.22 062	75	9.22 670	77	0.77 330	9.99 392	26
35	9.22 137	75	9.22 747	77	0.77 253	9.99 390	25
36	9.22 211	74	9.22 824	77	0.77 176	9.99 388	24
37	9.22 286	75	9.22 901	77	0.77 099	9.99 385	23
38	9.22 361	75	9.22 977	76	0.77 023	9.99 383	22
39	9.22 435	74	9.23 054	77	0.76 946	9.99 381	21
40	9.22 509	74	9.23 130	76	0.76 870	9.99 379	20
41	9.22 583	74	9.23 206	76	0.76 794	9.99 377	19
42	9.22 657	74	9.23 283	77	0.76 717	9.99 375	18
43	9.22 731	74	9.23 359	76	0.76 641	9.99 372	17
44	9.22 805	74	9.23 435	76	0.76 565	9.99 370	16
45	9.22 878	73	9.23 510	75	0.76 490	9.99 368	15
46	9.22 952	74	9.23 586	76	0.76 414	9.99 366	14
47	9.23 025	73	9.23 661	75	0.76 339	9.99 364	13
48	9.23 098	73	9.23 737	76	0.76 263	9.99 362	12
49	9.23 171	73	9.23 812	75	0.76 188	9.99 359	11
50	9.23 244	73	9.23 887	75	0.76 113	9.99 357	10
51	9.23 317	73	9.23 962	75	0.76 038	9.99 355	9
52	9.23 390	73	9.24 037	75	0.75 963	9.99 353	8
53	9.23 462	72	9.24 112	75	0.75 888	9.99 351	7
54	9.23 535	73	9.24 186	74	0.75 814	9.99 348	6
55	9.23 607	72	9.24 261	75	0.75 739	9.99 346	5
56	9.23 679	72	9.24 335	74	0.75 665	9.99 344	4
57	9.23 752	73	9.24 410	75	0.75 590	9.99 342	3
58	9.23 823	71	9.24 484	74	0.75 516	9.99 340	2
59	9.23 895	72	9.24 558	74	0.75 442	9.99 337	1
60	9.23 967	72	9.24 632	74	0.75 368	9.99 335	0
′	L. Cos.	d.	L. Cot.	c.d.	L. Tan.	L. Sin.	′

P. P.				
″	80	79	78	77
1	1.3	1.3	1.3	1.3
2	2.7	2.6	2.6	2.6
3	4.0	4.0	3.9	3.8
4	5.3	5.3	5.2	5.1
5	6.7	6.6	6.5	6.4
6	8.0	7.9	7.8	7.7
7	9.3	9.2	9.1	9.0
8	10.7	10.5	10.4	10.3
9	12.0	11.8	11.7	11.6
10	13.3	13.2	13.0	12.8
20	26.7	26.3	26.0	25.7
30	40.0	39.5	39.0	38.5
40	53.3	52.7	52.0	51.3
50	66.7	65.8	65.0	64.2

″	76	75	74	73
1	1.3	1.2	1.2	1.2
2	2.5	2.5	2.5	2.4
3	3.8	3.8	3.7	3.6
4	5.1	5.0	4.9	4.9
5	6.3	6.2	6.2	6.1
6	7.6	7.5	7.4	7.3
7	8.9	8.8	8.6	8.5
8	10.1	10.0	9.9	9.7
9	11.4	11.2	11.1	11.0
10	12.7	12.5	12.3	12.2
20	25.3	25.0	24.7	24.3
30	38.0	37.5	37.0	36.5
40	50.7	50.0	49.3	48.7
50	63.3	62.5	61.7	60.8

″	72	71	3	2
1	1.2	1.2	0.0	0.0
2	2.4	2.4	0.1	0.1
3	3.6	3.6	0.2	0.1
4	4.8	4.7	0.2	0.1
5	6.0	5.9	0.2	0.2
6	7.2	7.1	0.3	0.2
7	8.4	8.3	0.4	0.2
8	9.6	9.5	0.4	0.3
9	10.8	10.6	0.4	0.3
10	12.0	11.8	0.5	0.3
20	24.0	23.7	1.0	0.7
30	36.0	35.5	1.5	1.0
40	48.0	47.3	2.0	1.3
50	60.0	59.2	2.5	1.7

	3 / 79	3 / 78	3 / 77
0	13.2	13.0	12.8
1	39.5	39.0	38.5
2	65.8	65.0	64.2
3			

	3 / 76	3 / 75	3 / 74
0	12.7	12.5	12.3
1	38.0	37.5	37.0
2	63.3	62.5	61.7
3			

P. P.

9° (279°) (260°) 80°

10° (190°) (349°) **169°**

′	L. Sin.	d.	L. Tan.	c.d.	L. Cot.	L. Cos.	d.	′
0	9.23 967		9.24 632		0.75 368	9.99 335	2	**60**
1	9.24 039	72	9.24 706	74	0.75 294	9.99 333	2	59
2	9.24 110	71	9.24 779	73	0.75 221	9.99 331	2	58
3	9.24 181	71	9.24 853	74	0.75 147	9.99 328	2	57
4	9.24 253	72	9.24 926	73	0.75 074	9.99 326	2	56
5	9.24 324	71	9.25 000	74	0.75 000	9.99 324	2	55
6	9.24 395	71	9.25 073	73	0.74 927	9.99 322	2	54
7	9.24 466	71	9.25 146	73	0.74 854	9.99 319	3	53
8	9.24 536	70	9.25 219	73	0.74 781	9.99 317	2	52
9	9.24 607	71	9.25 292	73	0.74 708	9.99 315	2	51
10	9.24 677	70	9.25 365	73	0.74 635	9.99 313	2	**50**
11	9.24 748	71	9.25 437	72	0.74 563	9.99 310	3	49
12	9.24 818	70	9.25 510	73	0.74 490	9.99 308	2	48
13	9.24 888	70	9.25 582	73	0.74 418	9.99 306	2	47
14	9.24 958	70	9.25 655	73	0.74 345	9.99 304	2	46
15	9.25 028	70	9.25 727	72	0.74 273	0.99 301	3	45
16	9.25 098	70	9.25 799	72	0.74 201	9.99 299	2	44
17	9.25 168	70	9.25 871	72	0.74 129	9.99 297	2	43
18	9.25 237	69	9.25 943	72	0.74 057	9.99 294	3	42
19	9.25 307	70	9.26 015	72	0.73 985	9.99 292	2	41
20	9.25 376	69	9.26 086	71	0.73 914	9.99 290	2	**40**
21	9.25 445	69	9.26 158	72	0.73 842	9.99 288	3	39
22	9.25 514	69	9.26 229	71	0.73 771	9.99 285	2	38
23	9.25 583	69	9.26 301	72	0.73 699	9.99 283	2	37
24	9.25 652	69	9.26 372	71	0.73 628	9.99 281	2	36
25	9.25 721	69	9.26 443	71	0.73 557	9.99 278	3	35
26	9.25 790	69	9.26 514	71	0.73 486	9.99 276	2	34
27	9.25 858	68	9.26 585	71	0.73 415	9.99 274	2	33
28	9.25 927	69	9.26 655	70	0.73 345	9.99 271	3	32
29	9.25 995	68	9.26 726	71	0.73 274	9.99 269	2	31
30	9.26 063	68	9.26 797	71	0.73 203	9.99 267	2	**30**
31	9.26 131	68	9.26 867	70	0.73 133	9.99 264	3	29
32	9.26 199	68	9.26 937	70	0.73 063	9.99 262	2	28
33	9.26 267	68	9.27 008	71	0.72 992	9.99 260	2	27
34	9.26 335	68	9.27 078	70	0.72 922	9.99 257	3	26
35	9.26 403	68	9.27 148	70	0.72 852	9.99 255	2	25
36	9.26 470	67	9.27 218	70	0.72 782	9.99 252	3	24
37	9.26 538	68	9.27 288	70	0.72 712	9.99 250	2	23
38	9.26 605	67	9.27 357	69	0.72 643	9.99 248	2	22
39	9.26 672	67	9.27 427	70	0.72 573	9.99 245	3	21
40	9.26 739	67	9.27 496	69	0.72 504	9.99 243	2	**20**
41	9.26 806	67	9.27 566	70	0.72 434	9.99 241	2	19
42	9.26 873	67	9.27 635	69	0.72 365	9.99 238	3	18
43	9.26 940	67	9.27 704	69	0.72 296	9.99 236	2	17
44	9.27 007	66	9.27 773	69	0.72 227	9.99 233	3	16
45	9.27 073	67	9.27 842	69	0.72 158	9.99 231	2	15
46	9.27 140	67	9.27 911	69	0.72 089	9.99 229	2	14
47	9.27 206	66	9.27 980	69	0.72 020	9.99 226	3	13
48	9.27 273	67	9.28 049	69	0.71 951	9.99 224	2	12
49	9.27 339	66	9.28 117	68	0.71 883	9.99 221	3	11
50	9.27 405	66	9.28 186	69	0.71 814	9.99 219	2	**10**
51	9.27 471	66	9.28 254	68	0.71 746	9.99 217	2	9
52	9.27 537	66	9.28 323	69	0.71 677	9.99 214	3	8
53	9.27 602	65	9.28 391	68	0.71 609	9.99 212	2	7
54	9.27 668	66	9.28 459	68	0.71 541	9.99 209	3	6
55	9.27 734	66	9.28 527	68	0.71 473	9.99 207	2	5
56	9.27 799	65	9.28 595	68	0.71 405	9.99 204	3	4
57	9.27 864	65	9.28 662	67	0.71 338	9.99 202	2	3
58	9.27 930	66	9.28 730	68	0.71 270	9.99 200	2	2
59	9.27 995	65	9.28 798	68	0.71 202	9.99 197	3	1
60	9.28 060	65	9.28 865	67	0.71 135	9.99 195	2	**0**
′	L. Cos.	d.	L. Cot.	c.d.	L. Tan.	L. Sin.	d.	′

100° (280°) (259°) **79°**

P. P.			
″	**74**	**73**	**72**
1	1.2	1.2	1.2
2	2.5	2.4	2.4
3	3.7	3.6	3.6
4	4.9	4.9	4.8
5	6.2	6.1	6.0
6	7.4	7.3	7.2
7	8.6	8.5	8.4
8	9.9	9.7	9.6
9	11.1	11.0	10.8
10	12.3	12.2	12.0
20	24.7	24.3	24.0
30	37.0	36.5	36.0
40	49.3	48.7	48.0
50	61.7	60.8	60.0

P. P.			
″	**71**	**70**	**69**
1	1.2	1.2	1.2
2	2.4	2.3	2.3
3	3.6	3.5	3.4
4	4.7	4.7	4.6
5	5.9	5.8	5.8
6	7.1	7.0	6.9
7	8.3	8.2	8.0
8	9.5	9.3	9.2
9	10.6	10.5	10.4
10	11.8	11.7	11.5
20	23.7	23.3	23.0
30	35.5	35.0	34.5
40	47.3	46.7	46.0
50	59.2	58.3	57.5

P. P.			
″	**68**	**67**	**66**
1	1.1	1.1	1.1
2	2.3	2.2	2.2
3	3.4	3.4	3.3
4	4.5	4.5	4.4
5	5.7	5.6	5.5
6	6.8	6.7	6.6
7	7.9	7.8	7.7
8	9.1	8.9	8.8
9	10.2	10.0	9.9
10	11.3	11.2	11.0
20	22.7	22.3	22.0
30	34.0	33.5	33.0
40	45.3	44.7	44.0
50	56.7	55.8	55.0

	3/74	**3/73**	**3/72**
0	12.3	12.2	12.0
1	37.0	36.5	36.0
2	61.7	60.8	60.0
3			

	3/71	**3/70**	**3/69**	**3/68**
0				
1	11.8	11.7	11.5	11.3
2	35.5	35.0	34.5	34.0
3	59.2	58.3	57.5	56.7

11° (191°) (348°) **168°**

′	L. Sin.	d.	L. Tan.	c.d.	L. Cot.	L. Cos.	d.	′
0	9.28 060		9.28 865		0.71 135	9.99 195		**60**
1	9.28 125	65	9.28 933	68	0.71 067	9.99 192	3	59
2	9.28 190	65	9.29 000	67	0.71 000	9.99 190	2	58
3	9.28 254	64	9.29 067	67	0.70 933	9.99 187	3	57
4	9.28 319	65	9.29 134	67	0.70 866	9.99 185	2	56
5	9.28 384	65	9.29 201	67	0.70 799	9.99 182	3	55
6	9.28 448	64	9.29 268	67	0.70 732	9.99 180	2	54
7	9.28 512	64	9.29 335	67	0.70 665	9.99 177	3	53
8	9.28 577	65	9.29 402	67	0.70 598	9.99 175	2	52
9	9.28 641	64	9.99 468	66	0.70 532	9.99 172	3	51
10	9.28 705	64	9.29 535	67	0.70 465	9.99 170	2	50
11	9.28 769	64	9.29 601	66	0.70 399	9.99 167	3	49
12	9.28 833	64	9.29 668	67	0.70 332	9.99 165	2	48
13	9.28 896	63	9.29 734	66	0.70 266	9.99 162	3	47
14	9.28 960	64	9.29 800	66	0.70 200	9.99 160	2	46
15	9.29 024	64	9.29 866	66	0.70 134	9.99 157	3	45
16	9.29 087	63	9.29 932	66	0.70 068	9.99 155	2	44
17	9.29 150	63	9.29 998	66	0.70 002	9.99 152	3	43
18	9.29 214	64	9.30 064	66	0.69 936	9.99 150	2	42
19	9.29 277	63	9.30 130	66	0.69 870	9.99 147	3	41
20	9.29 340	63	9.30 195	65	0.69 805	9.99 145	2	**40**
21	9.29 403	63	9.30 261	66	0.69 739	9.99 142	3	39
22	9.29 466	63	9.30 326	65	0.69 674	9.99 140	2	38
23	9.29 529	63	9.30 391	65	0.69 609	9.99 137	3	37
24	9.29 591	62	9.30 457	66	0.69 543	9.99 135	2	36
25	9.29 654	63	9.30 522	65	0.69 478	9.99 132	3	35
26	9.29 716	62	9.30 587	65	0.69 413	9.99 130	2	34
27	9.29 779	63	9.30 652	65	0.69 348	9.99 127	3	33
28	9.29 841	62	9.30 717	65	0.69 283	9.99 124	3	32
29	9.29 903	62	9.30 782	65	0.69 218	9.99 122	2	31
30	9.29 966	63	9.30 846	64	0.69 154	9.99 119	3	**30**
31	9.30 028	62	9.20 911	65	0.69 089	9.99 117	2	29
32	9.30 090	62	9.30 975	64	0.69 025	9.99 114	3	28
33	9.30 151	61	9.31 040	65	0.68 960	9.99 112	2	27
34	9.30 213	62	9.31 104	64	0.68 896	9.99 109	3	26
35	9.30 275	62	9.31 168	64	0.68 832	9.99 106	3	25
36	9.30 336	61	9.31 233	65	0.68 767	9.99 104	2	24
37	9.30 398	62	9.31 297	64	0.68 703	9.99 101	3	23
38	9.30 459	61	9.31 361	64	0.68 639	9.99 099	2	22
39	9.30 521	62	9.31 425	64	0.68 575	9.99 096	3	21
40	9.30 582	61	9.31 489	64	0.68 511	9.99 093	3	**20**
41	9.30 643	61	9.31 552	63	0.68 448	9.99 091	2	19
42	9.30 704	61	9.31 616	64	0.68 384	9.99 088	3	18
43	9.30 765	61	9.31 679	63	0.68 321	9.99 086	2	17
44	9.30 826	61	9.31 743	64	0.68 257	9.99 083	3	16
45	9.30 887	61	9.31 806	63	0.68 194	9.99 080	3	15
46	9.30 947	60	9.31 870	64	0.68 130	9.99 078	2	14
47	9.31 008	61	9.31 933	63	0.68 067	9.99 075	3	13
48	9.31 068	60	9.31 996	63	0.68 004	9.99 072	3	12
49	9.31 129	61	9.32 059	63	0.67 941	9.99 070	2	11
50	9.31 189	60	9.32 122	63	0.67 878	9.99 067	3	**10**
51	9.31 250	61	9.32 185	63	0.67 815	9.99 064	3	9
52	9.31 310	60	9.32 248	63	0.67 752	9.99 062	3	8
53	9.31 370	60	9.32 311	63	0.67 689	9.99 059	3	7
54	9.31 430	60	9.32 373	62	0.67 627	9.99 056	3	6
55	9.31 490	60	9.32 436	63	0.67 564	9.99 054	2	5
56	9.31 549	59	9.32 498	62	0.67 502	9.99 051	3	4
57	9.31 609	60	9.32 561	63	0.67 439	9.99 048	3	3
58	9.31 669	60	9.32 623	62	0.67 377	9.99 046	3	2
59	9.31 728	59	9.32 685	62	0.67 315	9.99 043	3	1
60	9.31 788	60	9.32 747	62	0.67 253	9.99 040	3	**0**
′	L. Cos.	d.	L. Cot.	c.d.	L. Tan.	L. Sin.	d.	′

P. P.			
″	**65**	**64**	**63**
1	1.1	1.1	1.0
2	2.2	2.1	2.1
3	3.2	3.2	3.2
4	4.3	4.3	4.2
5	5.4	5.3	5.2
6	6.5	6.4	6.3
7	7.6	7.5	7.4
8	8.7	8.5	8.4
9	9.8	9.6	9.4
10	10.8	10.7	10.5
20	21.7	21.3	21.0
30	32.5	32.0	31.5
40	43.3	42.7	42.0
50	54.2	53.3	52.5
″	**62**	**61**	**60**
1	1.0	1.0	1.0
2	2.1	2.0	2.0
3	3.1	3.0	3.0
4	4.1	4.1	4.0
5	5.2	5.1	5.0
6	6.2	6.1	6.0
7	7.2	7.1	7.0
8	8.3	8.1	8.0
9	9.3	9.2	9.0
10	10.3	10.2	10.0
20	20.7	20.3	20.0
30	31.0	30.5	30.0
40	41.3	40.7	40.0
50	51.7	50.8	50.0
″	**59**	**3**	**2**
1	1.0	0.0	0.0
2	2.0	0.1	0.1
3	3.0	0.2	0.1
4	3.9	0.2	0.1
5	4.9	0.2	0.2
6	5.9	0.3	0.2
7	6.9	0.4	0.2
8	7.9	0.4	0.3
9	8.8	0.4	0.3
10	9.8	0.5	0.3
20	19.7	1.0	0.7
30	29.5	1.5	1.0
40	39.3	2.0	1.3
50	49.2	2.5	1.7

	$\frac{3}{67}$	$\frac{3}{66}$	$\frac{3}{65}$
0	11.2	11.0	10.8
1	33.5	33.0	32.5
2	55.8	55.0	54.2
3			

	$\frac{3}{64}$	$\frac{3}{63}$	$\frac{3}{62}$
0	10.7	10.5	10.3
1	32.0	31.5	31.0
2	53.3	52.5	51.7
3			

P. P.

101° (281°) (258°) **78°**

12° (192°) (347°) **167°**

′	L. Sin.	d.	L. Tan.	c.d.	L. Cot.	L. Cos.	d.	′
0	9.31 788		9.32 747		0.67 253	9.99 040		**60**
1	9.31 847	59	9.32 810	63	0.67 190	9.99 038	2	59
2	9.31 907	60	9.32 872	62	0.67 128	9.99 035	3	58
3	9.31 966	59	9.32 933	61	0.67 067	9.99 032	3	57
4	9.32 025	59	9.32 995	62	0.67 005	9.99 030	2	56
5	9.32 084	59	9.33 057	62	0.66 943	9.99 027	3	55
6	9.32 143	59	9.33 119	62	0.66 881	9.99 024	3	54
7	9.32 202	59	9.33 180	61	0.66 820	9.99 022	2	53
8	9.32 261	59	9.33 242	62	0.66 758	9.99 019	3	52
9	9.32 319	58	9.33 303	61	0.66 697	9.99 016	3	51
10	9.32 378	59	9.33 365	62	0.66 635	9.99 013	3	**50**
11	9.32 437	59	9.33 426	61	0.66 574	9.99 011	2	49
12	9.32 495	58	9.33 487	61	0.66 513	9.99 008	3	48
13	9.32 553	58	9.33 548	61	0.66 452	9.99 005	3	47
14	9.32 612	59	9.33 609	61	0.66 391	9.99 002	3	46
15	9.32 670	58	9.33 670	61	0.66 330	9.99 000	2	45
16	9.32 728	58	9.33 731	61	0.66 269	9.98 997	3	44
17	9.32 786	58	9.33 792	61	0.66 208	9.98 994	3	43
18	9.32 844	58	9.33 853	61	0.66 147	9.98 991	3	42
19	9.32 902	58	9.33 913	60	0.66 087	9.98 989	2	41
20	9.32 960	58	9.33 974	61	0.66 026	9.98 986	3	**40**
21	9.33 018	57	9.34 034	60	0.65 966	9.98 983	3	39
22	9.33 075	58	9.34 095	61	0.65 905	9.98 980	3	38
23	9.33 133	57	9.34 155	60	0.65 845	9.98 978	2	37
24	9.33 190	57	9.34 215	60	0.65 785	9.98 975	3	36
25	9.33 248	58	9.34 276	61	0.65 724	9.98 972	3	35
26	9.33 305	57	9.34 336	60	0.65 664	9.98 969	3	34
27	9.33 362	57	9.34 396	60	0.65 604	9.98 967	2	33
28	9.33 420	58	9.34 456	60	0.65 544	9.98 964	3	32
29	9.33 477	57	9.34 516	60	0.65 484	9.98 961	3	31
30	9.33 534	57	9.34 576	60	0.65 424	9.98 958	3	**30**
31	9.33 591	57	9.34 635	59	0.65 365	9.98 955	3	29
32	9.33 647	56	9.34 695	60	0.65 305	9.98 953	2	28
33	9.33 704	57	9.34 755	60	0.65 245	9.98 950	3	27
34	9.33 761	57	9.34 814	59	0.65 186	9.98 947	3	26
35	9.33 818	57	9.34 874	60	0.65 126	9.98 944	3	25
36	9.33 874	56	9.34 933	59	0.65 067	9.98 941	3	24
37	9.33 931	57	9.34 992	59	0.65 008	9.98 938	3	23
38	9.33 987	56	9.35 051	59	0.64 949	9.98 936	2	22
39	9.34 043	56	9.35 111	60	0.64 889	9.98 933	3	21
40	9.34 100	57	9.35 170	59	0.64 830	9.98 930	3	**20**
41	9.34 156	56	9.35 229	59	0.64 771	9.99 927	3	19
42	9.34 212	56	9.35 288	59	0.64 712	9.98 924	3	18
43	9.34 268	56	9.35 347	59	0.64 653	9.98 921	3	17
44	9.34 324	56	9.35 405	58	0.64 595	9.98 919	2	16
45	9.34 380	56	9.35 464	59	0.64 536	9.98 916	3	15
46	9.34 436	56	9.35 523	59	0.64 477	9.98 913	3	14
47	9.34 491	55	9.35 581	58	0.64 419	9.98 910	3	13
48	9.34 547	56	9.35 640	59	0.64 360	9.98 907	3	12
49	9.34 602	55	9.35 698	58	0.64 302	9.98 904	3	11
50	9.34 658	56	9.35 757	59	0.64 243	9.98 901	3	**10**
51	9.34 713	55	9.35 815	58	0.64 185	9.98 898	3	9
52	9.34 769	56	9.35 873	58	0.64 127	9.98 896	2	8
53	9.34 824	55	9.35 931	58	0.64 069	9.98 893	3	7
54	9.34 879	55	9.35 989	58	0.64 011	9.98 890	3	6
55	9.34 934	55	9.36 047	58	0.63 953	9.98 887	3	5
56	9.34 989	55	9.36 105	58	0.63 895	9.98 884	3	4
57	9.35 044	55	9.36 163	58	0.63 837	9.98 881	3	3
58	9.35 099	55	9.36 221	58	0.63 779	9.98 878	3	2
59	9.35 154	55	9.36 279	58	0.63 721	9.98 875	3	1
60	9.35 209	55	9.36 336	57	0.63 664	9.98 872	3	**0**
′	L. Cos.	d.	L. Cot.	c.d.	L. Tan.	L. Sin.	d.	′

P. P.			
″	**63**	**62**	**61**
1	1.0	1.0	1.0
2	2.1	2.1	2.0
3	3.2	3.1	3.0
4	4.2	4.1	4.1
5	5.2	5.2	5.1
6	6.3	6.2	6.1
7	7.4	7.2	7.1
8	8.4	8.3	8.1
9	9.4	9.3	9.2
10	10.5	10.3	10.2
20	21.0	20.7	20.3
30	31.5	31.0	30.5
40	42.0	41.3	40.7
50	52.5	51.7	50.8

P. P.			
″	**60**	**59**	**58**
1	1.0	1.0	1.0
2	2.0	2.0	1.9
3	3.0	3.0	2.9
4	4.0	3.9	3.9
5	5.0	4.9	4.8
6	6.0	5.9	5.8
7	7.0	6.9	6.8
8	8.0	7.9	7.7
9	9.0	8.8	8.7
10	10.0	9.8	9.7
20	20.0	19.7	19.3
30	30.0	29.5	29.0
40	40.0	39.3	38.7
50	50.0	49.2	48.3

P. P.			
″	**57**	**56**	**55**
1	1.0	0.9	0.9
2	1.9	1.9	1.8
3	2.8	2.8	2.8
4	3.8	3.7	3.7
5	4.8	4.7	4.6
6	5.7	5.6	5.5
7	6.6	6.5	6.4
8	7.6	7.5	7.3
9	8.6	8.4	8.2
10	9.5	9.3	9.2
20	19.0	18.7	18.3
30	28.5	28.0	27.5
40	38.0	37.3	36.7
50	47.5	46.7	45.8

	3/62	**3/61**	**3/60**
0	10.3	10.2	10.0
1	31.0	30.5	30.0
2	51.7	50.8	50.0
3			

	3/59	**3/58**	**3/57**
0	9.8	9.7	9.5
1	29.5	29.0	28.5
2	49.2	48.3	47.5
3			

P. P.

102° (282°) (257°) **77°**

13° (193°) (346°) **166°**

′	L. Sin.	d.	L. Tan.	c.d.	L. Cot.	L. Cos.	d.	′
0	9.35 209		9.36 336		0.63 664	9.98 872		**60**
1	9.35 263	54	9.36 394	58	0.63 606	9.98 869	3	59
2	9.35 318	55	9.36 452	58	0.63 548	9.98 867	2	58
3	9.35 373	55	9.36 509	57	0.63 491	9.98 864	3	57
4	9.35 427	54	9.36 566	57	0.63 434	9.98 861	3	56
5	9.35 481	54	9.36 624	58	0.63 376	9.98 858	3	55
6	9.35 536	55	9.36 681	57	0.63 319	9.98 855	3	54
7	9.35 590	54	9.36 738	57	0.63 262	9.98 852	3	53
8	9.35 644	54	9.36 795	57	0.63 205	9.98 849	3	52
9	9.35 698	54	9.36 852	57	0.63 148	9.98 846	3	51
10	9.35 752	54	9.36 909	57	0.63 091	9.98 843	3	**50**
11	9.35 806	54	9.36 966	57	0.63 034	9.98 840	3	49
12	9.35 860	54	9.37 023	57	0.62 977	9.98 837	3	48
13	9.35 914	54	9.37 080	57	0.62 920	9.98 834	3	47
14	9.35 968	54	9.37 137	57	0.62 863	9.98 831	3	46
15	9.36 022	54	9.37 193	56	0.62 807	9.98 828	3	45
16	9.36 075	53	9.37 250	57	0.62 750	9.98 825	3	44
17	9.36 129	54	9.37 306	56	0.62 694	9.98 822	3	43
18	9.36 182	53	9.37 363	57	0.62 637	9.98 819	3	42
19	9.36 236	54	9.37 419	56	0.62 581	9.98 816	3	41
20	9.36 289	53	9.37 476	57	0.62 524	9.98 813	3	**40**
21	9.36 342	53	9.37 532	56	0.62 468	9.98 810	3	39
22	9.36 395	53	9.37 588	56	0.62 412	9.98 807	3	38
23	9.36 449	54	9.37 644	56	0.62 356	9.98 804	3	37
24	9.36 502	53	9.37 700	56	0.62 300	9.98 801	3	36
25	9.36 555	53	9.37 756	56	0.62 244	9.98 798	3	35
26	9.36 608	53	9.37 812	56	0.62 188	9.98 795	3	34
27	9.36 660	52	9.37 868	56	0.62 132	9.98 792	3	33
28	9.36 713	53	9.37 924	56	0.62 076	9.98 789	3	32
29	9.36 766	53	9.37 980	56	0.62 020	9.98 786	3	31
30	9.36 819	53	9.38 035	55	0.61 965	9.98 783	3	**30**
31	9.36 871	52	9.38 091	56	0.61 909	9.98 780	3	29
32	9.36 924	53	9.38 147	56	0.61 853	9.98 777	3	28
33	9.36 976	52	9.38 202	55	0.61 798	9.98 774	3	27
34	9.37 028	52	9.38 257	55	0.61 743	9.98 771	3	26
35	9.37 081	53	9.38 313	56	0.61 687	9.98 768	3	25
36	9.37 133	52	9.38 368	55	0.61 632	9.98 765	3	24
37	9.37 185	52	9.38 423	55	0.61 577	9.98 762	3	23
38	9.37 237	52	9.38 479	56	0.61 521	9.98 759	3	22
39	9.37 289	52	9.38 534	55	0.61 466	9.98 756	3	21
40	9.37 341	52	9.38 589	55	0.61 411	9.98 753	3	**20**
41	9.37 393	52	9.38 644	55	0.61 356	9.98 750	3	19
42	9.37 445	52	9.38 699	55	0.61 301	9.98 746	4	18
43	9.37 497	52	9.38 754	55	0.61 246	9.98 743	3	17
44	9.37 549	52	9.38 808	54	0.61 192	9.98 740	3	16
45	9.37 600	51	9.38 863	55	0.61 137	9.98 737	3	15
46	9.37 652	52	9.38 918	55	0.61 082	9.98 734	3	14
47	9.37 703	51	9.38 972	54	0.61 028	9.98 731	3	13
48	9.37 755	52	9.39 027	55	0.60 973	9.98 728	3	12
49	9.37 806	51	9.39 082	55	0.60 918	9.98 725	3	11
50	9.37 858	52	9.39 136	54	0.60 864	9.98 722	3	**10**
51	9.37 909	51	9.39 190	54	0.60 810	9.98 719	3	9
52	9.37 960	51	9.39 245	55	0.60 755	9.98 716	3	8
53	9.38 011	51	9.39 299	54	0.60 701	9.98 712	4	7
54	9.38 062	51	9.39 353	54	0.60 647	9.98 709	3	6
55	9.38 113	51	9.39 407	54	0.60 593	9.98 706	3	5
56	9.38 164	51	9.39 461	54	0.60 539	9.98 703	3	4
57	9.38 215	51	9.39 515	54	0.60 485	9.98 700	3	3
58	9.38 266	51	9.39 569	54	0.60 431	9.98 697	3	2
59	9.38 317	51	9.39 623	54	0.60 377	9.98 694	3	1
60	9.38 368	51	9.39 677	54	0.60 323	9.98 690	4	**0**
′	L. Cos.	d.	L. Cot.	c.d.	L. Tan.	L. Sin.	d.	′

P. P.

″	57	56	55
1	1.0	0.9	0.9
2	1.9	1.9	1.8
3	2.8	2.8	2.8
4	3.8	3.7	3.7
5	4.8	4.7	4.6
6	5.7	5.6	5.5
7	6.6	6.5	6.4
8	7.6	7.5	7.3
9	8.6	8.4	8.2
10	9.5	9.3	9.2
20	19.0	18.7	18.3
30	28.5	28.0	27.5
40	38.0	37.3	36.7
50	47.5	46.7	45.8

″	54	53	52
1	0.9	0.9	0.9
2	1.8	1.8	1.7
3	2.7	2.6	2.6
4	3.6	3.5	3.5
5	4.5	4.4	4.3
6	5.4	5.3	5.2
7	6.3	6.2	6.1
8	7.2	7.1	6.9
9	8.1	8.0	7.8
10	9.0	8.8	8.7
20	18.0	17.7	17.3
30	27.0	26.5	26.0
40	36.0	35.3	34.7
50	45.0	44.2	43.3

″	51	4	3	2
1	0.8	0.1	0.0	0.0
2	1.7	0.1	0.1	0.1
3	2.6	0.2	0.2	0.1
4	3.4	0.3	0.2	0.1
5	4.2	0.3	0.2	0.2
6	5.1	0.4	0.3	0.2
7	6.0	0.5	0.4	0.2
8	6.8	0.5	0.4	0.3
9	7.6	0.6	0.4	0.3
10	8.5	0.7	0.5	0.3
20	17.0	1.3	1.0	0.7
30	25.5	2.0	1.5	1.0
40	34.0	2.7	2.0	1.3
50	42.5	3.3	2.5	1.7

	$\frac{4}{55}$	$\frac{4}{54}$	$\frac{3}{58}$	$\frac{3}{57}$
0				
1	6.9	6.8	9.7	9.5
2	20.6	20.2	29.0	28.5
3	34.4	33.8	48.3	47.5
4	48.1	47.2	—	—

	$\frac{3}{56}$	$\frac{3}{55}$	$\frac{3}{54}$
0	9.3	9.2	9.0
1	28.0	27.5	27.0
2	46.7	45.8	45.0
3			

P. P.

103° (283°) (256°) **76°**

14° (194°) (345°) **165°**

′	L. Sin.	d.	L. Tan.	c.d.	L. Cot.	L. Cos.	d.	
0	9.38 368		9.39 677		0.60 323	9.98 690		**60**
1	9.38 418	50	9.39 731	54	0.60 269	9.98 687	3	59
2	9.38 469	51	9.39 785	54	0.60 215	9.98 684	3	58
3	9.38 519	50	9.39 838	53	0.60 162	9.98 681	3	57
4	9.38 570	51	9.39 892	54	0.60 108	9.98 678	3	56
5	9.38 620	50	9.39 945	53	0.60 055	9.98 675	3	55
6	9.38 670	50	9.39 999	54	0.60 001	9.98 671	4	54
7	9.38 721	51	9.40 052	53	0.59 948	9.98 668	3	53
8	9.38 771	50	9.40 106	54	0.59 894	9.98 665	3	52
9	9.38 821	50	9.40 159	53	0.59 841	9.98 662	3	51
10	9.38 871	50	9.40 212	53	0.59 788	9.98 659	3	**50**
11	9.38 921	50	9.40 266	54	0.59 734	9.98 656	4	49
12	9.38 971	50	9.40 319	53	0.59 681	9.98 652	3	48
13	9.39 021	50	9.40 372	53	0.59 628	9.98 649	3	47
14	9.39 071	50	9.40 425	53	0.59 575	9.98 646	3	46
15	9.39 121	50	9.40 478	53	0.59 522	9.98 643	3	45
16	9.39 170	49	9.40 531	53	0.59 469	9.98 640	3	44
17	9.39 220	50	9.40 584	53	0.59 416	9.98 636	4	43
18	9.39 270	50	9.40 636	52	0.59 364	9.98 633	3	42
19	9.39 319	49	9.40 689	53	0.59 311	9.98 630	3	41
20	9.39 369	50	9.40 742	53	0.59 258	9.98 627	4	**40**
21	9.39 418	49	9.40 795	53	0.59 205	9.98 623	3	39
22	9.39 467	49	9.40 847	52	0.59 153	9.98 620	3	38
23	9.39 517	50	9.40 900	53	0.59 100	9.98 617	3	37
24	9.39 566	49	9.40 952	52	0.59 048	9.98 614	4	36
25	9.39 615	49	9.41 005	53	0.58 995	9.98 610	3	35
26	9.39 664	49	9.41 057	52	0.58 943	9.98 607	3	34
27	9.39 713	49	9.41 109	52	0.58 891	9.98 604	3	33
28	9.39 762	49	9.41 161	52	0.58 839	9.98 601	4	32
29	9.39 811	49	9.41 214	53	0.58 786	9.98 597	4	31
30	9.39 860	49	9.41 266	52	0.58 734	9.98 594	3	**30**
31	9.39 909	49	9.41 318	52	0.58 682	9.98 591	3	29
32	9.39 958	49	9.41 370	52	0.58 630	9.98 588	4	28
33	9.40 006	48	9.41 422	52	0.58 578	9.98 584	3	27
34	9.40 055	49	9.41 474	52	0.58 526	9.98 581	3	26
35	9.40 103	48	9.41 526	52	0.58 474	9.98 578	3	25
36	9.40 152	49	9.41 578	52	0.58 422	9.98 574	4	24
37	9.40 200	48	9.41 629	51	0.58 371	9.98 571	3	23
38	9.40 249	49	9.41 681	52	0.58 319	9.98 568	3	22
39	9.40 297	48	9.41 733	52	0.58 267	9.98 565	3	21
40	9.40 346	49	9.41 784	51	0.58 216	9.98 561	4	**20**
41	9.40 394	48	9.41 836	52	0.58 164	9.98 558	3	19
42	9.40 442	48	9.41 887	51	0.58 113	9.98 555	3	18
43	9.40 490	48	9.41 939	52	0.58 061	9.98 551	4	17
44	9.40 538	48	9.41 990	51	0.58 010	9.98 548	3	16
45	9.40 586	48	9.42 041	51	0.57 959	9.98 545	3	15
46	9.40 634	48	9.42 093	52	0.57 907	9.98 541	4	14
47	9.40 682	48	9.42 144	51	0.57 856	9.98 538	3	13
48	9.40 730	48	9.42 195	51	0.57 805	9.98 535	3	12
49	9.40 778	48	9.42 246	51	0.57 754	9.98 531	4	11
50	9.40 825	47	9.42 297	51	0.57 703	9.98 528	3	**10**
51	9.40 873	48	9.42 348	51	0.57 652	9.98 525	3	9
52	9.40 921	48	9.42 399	51	0.57 601	9.98 521	4	8
53	9.40 968	47	9.42 450	51	0.57 550	9.98 518	3	7
54	9.41 016	48	9.42 501	51	0.57 499	9.98 515	3	6
55	9.41 063	47	9.42 552	51	0.57 448	9.98 511	4	5
56	9.41 111	48	9.42 603	51	0.57 397	9.98 508	3	4
57	9.41 158	47	9.42 653	50	0.57 347	9.98 505	3	3
58	9.41 205	47	9.42 704	51	0.57 296	9.98 501	4	2
59	9.41 252	47	9.42 755	51	0.57 245	9.98 498	3	1
60	9.41 300	48	9.42 805	50	0.57 195	9.98 494	4	**0**
	L. Cos.	d.	L. Cot.	c.d.	L. Tan.	L. Sin.	d.	′

104° (284°) (255°) **75°**

P. P.			
″	**54**	**53**	**52**
1	0.9	0.9	0.9
2	1.8	1.8	1.7
3	2.7	2.6	2.6
4	3.6	3.5	3.5
5	4.5	4.4	4.3
6	5.4	5.3	5.2
7	6.3	6.2	6.1
8	7.2	7.1	6.9
9	8.1	8.0	7.8
10	9.0	8.8	8.7
20	18.0	17.7	17.3
30	27.0	26.5	26.0
40	36.0	35.3	34.7
50	45.0	44.2	43.3
″	**51**	**50**	**49**
1	0.8	0.8	0.8
2	1.7	1.7	1.6
3	2.6	2.5	2.4
4	3.4	3.3	3.3
5	4.2	4.2	4.1
6	5.1	5.0	4.9
7	6.0	5.8	5.7
8	6.8	6.7	6.5
9	7.6	7.5	7.4
10	8.5	8.3	8.2
20	17.0	16.7	16.3
30	25.5	25.0	24.5
40	34.0	33.3	32.7
50	42.5	41.7	40.8

″	**48**	**47**	**4**	**3**
1	0.8	0.8	0.1	0.0
2	1.6	1.6	0.1	0.1
3	2.4	2.4	0.2	0.2
4	3.2	3.1	0.3	0.2
5	4.0	3.9	0.3	0.2
6	4.8	4.7	0.4	0.3
7	5.6	5.5	0.5	0.4
8	6.4	6.3	0.5	0.4
9	7.2	7.0	0.6	0.4
10	8.0	7.8	0.7	0.5
20	16.0	15.7	1.3	1.0
30	24.0	23.5	2.0	1.5
40	32.0	31.3	2.7	2.0
50	40.0	39.2	3.3	2.5

	4 / **54**	**4** / **53**	**4** / **52**	**4** / **51**
0				
1	6.8	6.6	6.5	6.4
2	20.2	19.9	19.5	19.1
3	33.8	33.1	32.5	31.9
4	47.2	46.4	45.5	44.6

	3 / **54**	**3** / **53**	**3** / **52**	**3** / **51**
0				
1	9.0	8.8	8.7	8.5
2	27.0	26.5	26.0	25.5
3	45.0	44.2	43.3	42.5

P. P.

15° (195°) (344°) **164°**

′	L. Sin.	d.	L. Tan.	c.d.	L. Cot	L. Cos.	d.	′
0	9.41 300		9.42 805		0.57 195	9.98 491	3	**60**
1	9.41 347	47	9.42 856	51	0.57 144	9.98 491	3	59
2	9.41 394	47	9.42 906	50	0.57 094	9.98 488	3	58
3	9.41 441	47	9.42 957	51	0.57 043	9.98 484	4	57
4	9.41 488	47	9.43 007	50	0.56 993	9.98 481	3	56
5	9.41 535	47	9.43 057	50	0.56 943	9.98 477	4	55
6	9.41 582	47	9.43 108	51	0.56 892	9.98 474	3	54
7	9.41 628	46	9.43 158	50	0.56 842	9.98 471	3	53
8	9.41 675	47	9.43 208	50	0.56 792	9.98 467	4	52
9	9.41 722	47	9.43 258	50	0.56 742	9.98 464	3	51
10	9.41 768	46	9.43 308	50	0.56 692	9.98 460	4	**50**
11	9.41 815	47	9.43 358	50	0.56 642	9.98 457	3	49
12	9.41 861	46	9.43 408	50	0.56 592	9.98 453	4	48
13	9.41 908	47	9.43 458	50	0.56 542	9.98 450	3	47
14	9.41 954	46	9.43 508	50	0.56 492	9.98 447	4	46
15	9.42 001	47	9.43 558	50	0.56 442	9.98 443	3	45
16	9.42 047	46	9.43 607	49	0.56 393	9.98 440	4	44
17	9.42 093	46	9.43 657	50	0.56 343	9.98 436	3	43
18	9.42 140	47	9.43 707	50	0.56 293	9.98 433	4	42
19	9.42 186	46	9.43 756	49	0.56 244	9.98 429	3	41
20	9.42 232	46	9.43 806	50	0.56 194	9.98 426	4	**40**
21	9.42 278	46	9.43 855	49	0.56 145	9.98 422	4	39
22	9.42 324	46	9.43 905	50	0.56 095	9.98 419	3	38
23	9.42 370	46	9.43 954	49	0.56 046	9.98 415	4	37
24	9.42 416	46	9.44 004	50	0.55 996	9.98 412	3	36
25	9.42 461	45	9.44 053	49	0.55 947	9.98 409	4	35
26	9.42 507	46	9.44 102	49	0.55 898	9.98 405	4	34
27	9.42 553	46	9.44 151	49	0.55 849	9.98 402	3	33
28	9.42 599	46	9.44 201	50	0.55 799	9.98 398	4	32
29	9.42 644	45	9.44 250	49	0.55 750	9.98 395	4	31
30	9.42 690	46	9.44 299	49	0.55 701	9.98 391	3	**30**
31	9.42 735	45	9.44 348	49	0.55 652	9.98 388	4	29
32	9.42 781	46	9.44 397	49	0.55 603	9.98 384	3	28
33	9.42 826	45	9.44 446	49	0.55 554	9.98 381	4	27
34	9.42 872	46	9.44 495	49	0.55 505	9.98 377	4	26
35	9.42 917	45	9.44 544	49	0.55 456	9.98 373	4	25
36	9.42 962	45	9.44 592	48	0.55 408	9.98 370	3	24
37	9.43 008	46	9.44 641	49	0.55 359	9.98 366	4	23
38	9.43 053	45	9.44 690	49	0.55 310	9.98 363	3	22
39	9.43 098	45	9.44 738	48	0.55 262	9.98 359	4	21
40	9.43 143	45	9.44 787	49	0.55 213	9.98 356	4	**20**
41	9.43 188	45	9.44 836	49	0.55 164	9.98 352	4	19
42	9.43 233	45	9.44 884	48	0.55 116	9.98 349	4	18
43	9.43 278	45	9.44 933	49	0.55 067	9.98 345	3	17
44	9.43 323	45	9.44 981	48	0.55 019	9.98 342	4	16
45	9.43 367	44	9.45 029	48	0.54 971	9.98 338	4	15
46	9.43 412	45	9.45 078	49	0.54 922	9.98 334	4	14
47	9.43 457	45	9.45 126	48	0.54 874	9.98 331	3	13
48	9.43 502	45	9.45 174	48	0.54 826	9.98 327	4	12
49	9.43 546	44	9.45 222	48	0.54 778	9.98 324	4	11
50	9.43 591	45	9.45 271	49	0.54 729	9.98 320	3	**10**
51	9.43 635	44	9.45 319	48	0.54 681	9.98 317	3	9
52	9.43 680	45	9.45 367	48	0.54 633	9.98 313	4	8
53	9.43 724	44	9.45 415	48	0.54 585	9.98 309	4	7
54	9.43 769	45	9.45 463	48	0.54 537	9.98 306	3	6
55	9.43 813	44	9.45 511	48	0.54 489	9.98 302	4	5
56	9.43 857	44	9.45 559	48	0.54 441	9.98 299	3	4
57	9.43 901	44	9.45 606	47	0.54 394	9.98 295	4	3
58	9.43 946	45	9.45 654	48	0.54 346	9.98 291	4	2
59	9.43 990	44	9.45 702	48	0.54 298	9.98 288	3	1
60	9.44 034	44	9.45 750	48	0.54 250	9.98 284	4	**0**
′	L. Cos.	d.	L. Cot.	c.d.	L. Tan.	L. Sin.	d.	′

P. P.			
″	**51**	**50**	**49**
1	0.8	0.8	0.8
2	1.7	1.7	1.6
3	2.6	2.5	2.4
4	3.4	3.3	3.3
5	4.2	4.2	4.1
6	5.1	5.0	4.9
7	6.0	5.8	5.7
8	6.8	6.7	6.5
9	7.6	7.5	7.4
10	8.5	8.3	8.2
20	17.0	16.7	16.3
30	25.5	25.0	24.5
40	34.0	33.3	32.7
50	42.5	41.7	40.8
″	**48**	**47**	**46**
1	0.8	0.8	0.8
2	1.6	1.6	1.5
3	2.4	2.4	2.3
4	3.2	3.1	3.1
5	4.0	3.9	3.8
6	4.8	4.7	4.6
7	5.6	5.5	5.4
8	6.4	6.3	6.1
9	7.2	7.0	6.9
10	8.0	7.8	7.7
20	16.0	15.7	15.3
30	24.0	23.5	23.0
40	32.0	31.3	30.7
50	40.0	39.2	38.3
″	**45**	**44**	**4**	**3**
1	0.8	0.7	0.1	0.0
2	1.5	1.5	0.1	0.1
3	2.2	2.2	0.2	0.2
4	3.0	2.9	0.3	0.2
5	3.8	3.7	0.3	0.2
6	4.5	4.4	0.4	0.3
7	5.2	5.1	0.5	0.4
8	6.0	5.9	0.5	0.4
9	6.8	6.6	0.6	0.4
10	7.5	7.3	0.7	0.5
20	15.0	14.7	1.3	1.0
30	22.5	22.0	2.0	1.5
40	30.0	29.3	2.7	2.0
50	37.5	36.7	3.3	2.5

	4 / **50**	**4** / **49**	**4** / **48**	**4** / **47**
0	6.2	6.1	6.0	5.9
1	18.8	18.4	18.0	17.6
2	31.2	30.6	30.0	29.4
3	43.8	42.9	42.0	41.1
4				

	3 / **51**	**3** / **50**	**3** / **49**	**3** / **48**
0	8.5	8.3	8.2	8.0
1	25.5	25.0	24.5	24.0
2	42.5	41.7	40.8	40.0
3				

P. P.

105° (285°) (254°) **74°**

16° (196°) (343°) **163°**

′	L. Sin.	d.	L. Tan.	c.d.	L. Cot.	L. Cos.	d.	′
0	9.44 034	44	9.45 750	47	0.54 250	9.98 284	3	**60**
1	9.44 078	44	9.45 797	48	0.54 203	9.98 281	4	59
2	9.44 122	44	9.45 845	47	0.54 155	9.98 277	4	58
3	9.44 166	44	9.45 892	47	0.54 108	9.98 273	4	57
4	9.44 210	44	9.45 940	47	0.54 060	9.98 270	3	56
5	9.44 253	43	9.45 987	48	0.54 013	9.98 266	4	55
6	9.44 297	44	9.46 035	47	0.53 965	9.98 262	4	54
7	9.44 341	44	9.46 082	48	0.53 918	9.98 259	3	53
8	9.44 385	44	9.46 130	47	0.53 870	9.98 255	4	52
9	9.44 428	43	9.46 177	47	0.53 823	9.98 251	4	51
10	9.44 472	44	9.46 224	47	0.53 776	9.98 248	3	**50**
11	9.44 516	44	9.46 271	48	0.53 729	9.98 244	4	49
12	9.44 559	43	9.46 319	47	0.53 681	9.98 240	4	48
13	9.44 602	43	9.46 366	47	0.53 634	9.98 237	4	47
14	9.44 646	44	9.46 413	47	0.53 587	9.98 233	4	46
15	9.44 689	43	9.46 460	47	0.53 540	9.98 229	4	45
16	9.44 733	44	9.46 507	47	0.53 493	9.98 226	3	44
17	9.44 776	43	9.46 554	47	0.53 446	9.98 222	4	43
18	9.44 819	43	9.46 601	47	0.53 399	9.98 218	4	42
19	9.44 862	43	9.46 648	46	0.53 352	9.98 215	4	41
20	9.44 905	43	9.46 694	47	0.53 306	9.98 211	4	**40**
21	9.44 948	43	9.46 741	47	0.53 259	9.98 207	4	39
22	9.44 992	44	9.46 788	47	0.53 212	9.98 204	3	38
23	9.45 035	43	9.46 835	46	0.53 165	9.98 200	4	37
24	9.45 077	42	9.46 881	47	0.53 119	9.98 196	4	36
25	9.45 120	43	9.46 928	47	0.53 072	9.98 192	4	35
26	9.45 163	43	9.46 975	46	0.53 025	9.98 189	3	34
27	9.45 206	43	9.47 021	47	0.52 979	9.98 185	4	33
28	9.45 249	43	9.47 068	46	0.52 932	9.98 181	4	32
29	9.45 292	42	9.47 114	46	0.52 886	9.98 177	3	31
30	9.45 334	43	9.47 160	47	0.52 840	9.98 174	4	**30**
31	9.45 377	42	9.47 207	46	0.52 793	9.98 170	4	29
32	9.45 419	43	9.47 253	46	0.52 747	9.98 166	4	28
33	9.45 462	42	9.47 299	46	0.52 701	9.98 162	4	27
34	9.45 504	43	9.47 346	47	0.52 654	9.98 159	3	26
35	9.45 547	42	9.47 392	46	0.52 608	9.98 155	4	25
36	9.45 589	42	9.47 438	46	0.52 562	9.98 151	4	24
37	9.45 632	43	9.47 484	46	0.52 516	9.98 147	4	23
38	9.45 674	42	9.47 530	46	0.52 470	9.98 144	3	22
39	9.45 716	42	9.47 576	46	0.52 424	9.98 140	4	21
40	9.45 758	43	9.47 622	46	0.52 378	9.98 136	4	**20**
41	9.45 801	42	9.47 668	46	0.52 332	9.98 132	4	19
42	9.45 843	42	9.47 714	46	0.52 286	9.98 129	4	18
43	9.45 885	42	9.47 760	46	0.52 240	9.98 125	4	17
44	9.45 927	42	9.47 806	46	0.52 194	9.98 121	4	16
45	9.45 969	42	9.47 852	45	0.52 148	9.98 117	4	15
46	9.46 011	42	9.47 897	46	0.52 103	9.98 113	4	14
47	9.46 053	42	9.47 943	46	0.52 057	9.98 110	3	13
48	9.46 095	42	9.47 989	46	0.52 011	9.98 106	4	12
49	9.46 136	41	9.48 035	46	0.51 965	9.98 102	4	11
50	9.46 178	42	9.48 080	45	0.51 920	9.98 098	4	**10**
51	9.46 220	42	9.48 126	46	0.51 874	9.98 094	4	9
52	9.46 262	42	9.48 171	45	0.51 829	9.98 090	4	8
53	9.46 303	41	9.48 217	46	0.51 783	9.98 087	3	7
54	9.46 345	42	9.48 262	45	0.51 738	9.98 083	4	6
55	9.46 386	41	9.48 307	45	0.51 693	9.98 079	4	5
56	9.46 428	42	9.48 353	46	0.51 347	9.98 075	4	4
57	9.46 469	41	9.48 398	45	0.51 602	9.98 071	4	3
58	9.46 511	42	9.48 443	45	0.51 557	9.98 067	4	2
59	9.46 552	41	9.48 489	46	0.51 511	9.98 063	4	1
60	9.46 594	42	9.48 534	45	0.51 466	9.98 060	3	**0**
′	L. Cos.	d.	L. Cot.	c.d.	L. Tan.	L. Sin.	d.	′

106° (286°) (253°) **73°**

P.P.			
″	**48**	**47**	**46**
1	0.8	0.8	0.8
2	1.6	1.6	1.5
3	2.4	2.4	2.3
4	3.2	3.1	3.1
5	4.0	3.9	3.8
6	4.8	4.7	4 6
7	5.6	5.5	5.4
8	6.4	6.3	6.1
9	7.2	7.0	6.9
10	8.0	7.8	7.7
20	16.0	15.7	15.3
30	24.0	23.5	23.0
40	32.0	31.3	30.7
50	40.0	39.2	38.3

″	**45**	**44**	**43**
1	0.8	0.7	0.7
2	1.5	1.5	1.4
3	2.2	2.2	2.2
4	3.0	2.9	2.9
5	3.8	3.7	3.6
6	4.5	4.4	4.3
7	5.2	5.1	5.0
8	6.0	5.9	5.7
9	6.8	6.6	6.4
10	7.5	7.3	7.2
20	15.0	14.7	14.3
30	22.5	22.0	21.5
40	30.0	29.3	28.7
50	37.5	36.7	35.8

″	**42**	**41**	**4**	**3**
1	0.7	0.7	0.1	0.0
2	1.4	1.4	0.1	0.1
3	2.1	2.0	0.2	0.2
4	2.8	2.7	0.3	0.2
5	3.5	3.4	0.3	0.2
6	4.2	4.1	0.4	0.3
7	4.9	4.8	0.5	0.4
8	5.6	5.5	0.5	0.4
9	6.3	6.2	0.6	0.4
10	7.0	6.8	0.7	0.5
20	14.0	13.7	1.3	1.0
30	21.0	20.5	2.0	1.5
40	28.0	27.3	2.7	2 0
50	35.0	34.2	3.3	2.5

	4/48	**4/47**	**4/46**	**4/45**
0	6.0	5.9	5.8	5.6
1	18.0	17.6	17.2	16.9
2	30.0	29.4	28.8	28.1
3	42.0	41.1	40.2	39.4

	3/48	**3/47**	**3/46**	**3/45**
0	8.0	7.8	7.7	7.5
1	24.0	23.5	23.0	22.5
2	40.0	39.2	38.3	37.5

P.P.

17° (197°) (342°) **162°**

′	L. Sin.	d.	L. Tan.	c.d.	L. Cot.	L. Cos.	d.	′
0	9.46 594		9.48 534		0.51 466	9.98 060	4	**60**
1	9.46 635	41	9.48 579	45	0.51 421	9.98 056	4	59
2	9.46 676	41	9.48 624	45	0.51 376	9.98 052	4	58
3	9.46 717	41	9.48 669	45	0.51 331	9.98 048	4	57
4	9.46 758	41	9.48 714	45	0.51 286	9.98 044	4	56
5	9.46 800	42	9.48 759	45	0.51 241	9.98 040	4	55
6	9.46 841	41	9.48 804	45	0.51 196	9.98 036	4	54
7	9.46 882	41	9.48 849	45	0.51 151	9.98 032	4	53
8	9.46 923	41	9.48 894	45	0.51 106	9.98 029	3	52
9	9.46 964	41	9.48 939	45	0.51 061	9.98 025	4	51
10	9.47 005		9.48 984		0.51 016	9.98 021	4	**50**
11	9.47 045	40	9.49 029	45	0.50 971	9.98 017	4	49
12	9.47 086	41	9.49 073	44	0.50 927	9.98 013	4	48
13	9.47 127	41	9.49 118	45	0.50 882	9.98 009	4	47
14	9.47 168	41	9.49 163	45	0.50 837	9.98 005	4	46
15	9.47 209	41	9.49 207	44	0.50 793	9.98 001	4	45
16	9.47 249	40	9.49 252	45	0.50 748	9.97 997	4	44
17	9.47 290	41	9.49 296	44	0.50 704	9.97 993	4	43
18	9.47 330	40	9.49 341	45	0.50 659	9.97 989	4	42
19	9.47 371	41	9.49 385	44	0.50 615	9.97 986	3	41
20	9.47 411	40	9.49 430	45	0.50 570	9.97 982	4	**40**
21	9.47 452	41	9.49 474	44	0.50 526	9.97 978	4	39
22	9.47 492	40	9.49 519	45	0.50 481	9.97 974	4	38
23	9.47 533	41	9.49 563	44	0.50 437	9.97 970	4	37
24	9.47 573	40	9.49 607	44	0.50 393	9.97 966	4	36
25	9.47 613	40	9.49 652	45	0.50 348	9.97 962	4	35
26	9.47 654	41	9.49 696	44	0.50 304	9.97 958	4	34
27	9.47 694	40	9.49 740	44	0.50 260	9.97 954	4	33
28	9.47 734	40	9.49 784	44	0.50 216	9.97 950	4	32
29	9.47 774	40	9.49 828	44	0.50 172	9.97 946	4	31
30	9.47 814	40	9.49 872	44	0.50 128	9.97 942	4	**30**
31	9.47 854	40	9.49 916	44	0.50 084	9.97 938	4	29
32	9.47 894	40	9.49 960	44	0.50 040	9.97 934	4	28
33	9.47 934	40	9.50 004	44	0.49 996	9.97 930	4	27
34	9.47 974	40	9.50 048	44	0.49 952	9.97 926	4	26
35	9.48 014	40	9.50 092	44	0.49 908	9.97 922	4	25
36	9.48 054	40	9.50 136	44	0.49 864	9.97 918	4	24
37	9.48 094	40	9.50 180	44	0.49 820	9.97 914	4	23
38	9.48 133	39	9.50 223	43	0.49 777	9.97 910	4	22
39	9.48 173	40	9.50 267	44	0.49 733	9.97 906	4	21
40	9.48 213	40	9.50 311	44	0.49 689	9.97 902	4	**20**
41	9.48 252	39	9.50 355	44	0.49 645	9.97 898	4	19
42	9.48 292	40	9.50 398	43	0.49 602	9.97 894	4	18
43	9.48 332	40	9.50 442	44	0.49 558	9.97 890	4	17
44	9.48 371	39	9.50 485	43	0.49 515	9.97 886	4	16
45	9.48 411	40	9.50 529	44	0.49 471	9.97 882	4	15
46	9.48 450	39	9.50 572	43	0.49 428	9.97 878	4	14
47	9.48 490	40	9.50 616	44	0.49 384	9.97 874	4	13
48	9.48 529	39	9.50 659	43	0.49 341	9.97 870	4	12
49	9.48 568	39	9.50 703	44	0.49 297	9.97 866	4	11
50	9.48 607	39	9.50 746	43	0.49 254	9.97 861	5	**10**
51	9.48 647	40	9.50 789	43	0.49 211	9.97 857	4	9
52	9.48 686	39	9.50 833	44	0.49 167	9.97 853	4	8
53	9.48 725	39	9.50 876	43	0.49 124	9.97 849	4	7
54	9.48 764	39	9.50 919	43	0.49 081	9.97 845	4	6
55	9.48 803	39	9.50 962	43	0.49 038	9.97 841	4	5
56	9.48 842	39	9.51 005	43	0.48 995	9.97 837	4	4
57	9.48 881	39	9.51 048	43	0.48 952	9.97 833	4	3
58	9.48 920	39	9.51 092	44	0.48 908	9.97 829	4	2
59	9.48 959	39	9.51 135	43	0.48 865	9.97 825	4	1
60	9.48 998	39	9.51 178	43	0.48 822	9.97 821	4	**0**
′	L. Cos.	d.	L. Cot.	c.d.	L. Tan.	L. Sin.	d.	′

P.P.			
″	**45**	**44**	**43**
1	0.8	0.7	0.7
2	1.5	1.5	1.4
3	2.2	2.2	2.2
4	3.0	2.9	2.9
5	3.8	3.7	3.6
6	4.5	4.4	4.3
7	5.2	5.1	5.0
8	6.0	5.9	5.7
9	6.8	6.6	6.4
10	7.5	7.3	7.2
20	15.0	14.7	14.3
30	22.5	22.0	21.5
40	30.0	29.3	28.7
50	37.5	36.7	35.8

	42	**41**	**40**
1	0.7	0.7	0.7
2	1.4	1.4	1.3
3	2.1	2.0	2.0
4	2.8	2.7	2.7
5	3.5	3.4	3.3
6	4.2	4.1	4.0
7	4.9	4.8	4.7
8	5.6	5.5	5.3
9	6.3	6.2	6.0
10	7.0	6.8	6.7
20	14.0	13.7	13.3
30	21.0	20.5	20.0
40	28.0	27.3	26.7
50	35.0	34.2	33.3

″	**39**	**5**	**4**	**3**
1	0.6	0.1	0.1	0.0
2	1.3	0.2	0.1	0.1
3	2.0	0.2	0.2	0.2
4	2.6	0.3	0.3	0.2
5	3.2	0.4	0.3	0.2
6	3.9	0.5	0.4	0.3
7	4.6	0.6	0.5	0.4
8	5.2	0.7	0.5	0.4
9	5.8	0.8	0.6	0.4
10	6.5	0.8	0.7	0.5
20	13.0	1.7	1.3	1.0
30	19.5	2.5	2.0	1.5
40	26.0	3.3	2.7	2.0
50	32.5	4.2	3.3	2.5

	5	**4**	**4**
	43	**45**	**44**
0	4.3	5.6	5.5
1	12.9	16.9	16.5
2	21.5	28.1	27.5
3	30.1	39.4	38.5
4	38.7	—	—

	4	**3**	**3**
	43	**45**	**44**
0	5.4	7.5	7.3
1	16.1	22.5	22.0
2	26.9	37.5	36.7
3	37.6	—	—

P.P.

107° (287°) (252°) **72°**

18° (198°) (341°) 161°

′	L. Sin.	d.	L. Tan.	c.d.	L. Cot.	L. Cos.	d	′
0	9.48 998	39	9.51 178	43	0.48 822	9.97 821	4	**60**
1	9.49 037	39	9.51 221	43	0.48 779	9.97 817	4	59
2	9.49 076	39	9.51 264	42	0.48 736	9.97 812	5	58
3	9.49 115	38	9.51 306	43	0.48 694	9.97 808	4	57
4	9.49 153	39	9.51 349	43	0.48 651	9.97 804	4	56
5	9.49 192	39	9.51 392	43	0.48 608	9.97 800	4	55
6	9.49 231	38	9.51 435	43	0.48 565	9.97 796	4	54
7	9.49 269	39	9.51 478	42	0.48 522	9.97 792	4	53
8	9.49 308	39	9.51 520	43	0.48 480	9.97 788	4	52
9	9.49 347	38	9.51 563	43	0.48 437	9.97 784	5	51
10	9.49 385	39	9.51 606	42	0.48 394	9.97 779	4	**50**
11	9.49 424	38	9.51 648	43	0.48 352	9.97 775	4	39
12	9.49 462	38	9.51 691	43	0.48 309	9.97 771	4	48
13	9.49 500	38	9.51 734	43	0.48 266	9.97 767	4	47
14	9.49 539	38	9.51 776	43	0.48 224	9.97 763	4	46
15	9.49 577	38	9.51 819	42	0.48 181	9.97 759	5	45
16	9.49 615	38	9.51 861	42	0.48 139	9.97 754	4	44
17	9.49 654	39	9.51 903	43	0.48 097	9.97 750	4	43
18	9.49 692	38	9.51 946	43	0.48 054	9.97 746	4	42
19	9.49 730	38	9.51 988	43	0.48 012	9.97 742	4	41
20	9.49 768	38	9.52 031	42	0.47 969	9.97 738	4	**40**
21	9.49 806	38	9.52 073	42	0.47 927	9.97 734	5	39
22	9.49 844	38	9.52 115	42	0.47 885	9.97 729	4	38
23	9.49 882	38	9.52 157	42	0.47 843	9.97 725	4	37
24	9.49 920	38	9.52 200	42	0.47 800	9.97 721	4	36
25	9.49 958	38	9.52 242	42	0.47 758	9.97 717	4	35
26	9.49 996	38	9.52 284	42	0.47 716	9.97 713	5	34
27	9.50 034	38	9.52 326	42	0.47 674	9.97 708	4	33
28	9.50 072	38	9.52 368	42	0.47 632	9.97 704	4	32
29	9.50 110	38	9.52 410	42	0.47 590	9.97 700	4	31
30	9.50 148	37	9.52 452	42	0.47 548	9.97 696	5	**30**
31	9.50 185	38	9.52 494	42	0.47 506	9.97 691	4	29
32	9.50 223	38	9.52 536	42	0.47 464	9.97 687	4	28
33	9.50 261	37	9.52 578	42	0.47 422	9.97 683	4	27
34	9.50 298	38	9.52 620	41	0.47 380	9.97 679	5	26
35	9.50 336	38	9.52 661	42	0.47 339	9.97 674	4	25
36	9.50 374	37	9.52 703	42	0.47 297	9.97 670	4	24
37	9.50 411	38	9.52 745	42	0.47 255	9.97 666	4	23
38	9.50 449	37	9.52 787	42	0.47 213	9.97 662	4	22
39	9.50 486	37	9.52 829	41	0.47 171	9.97 657	5	21
40	9.50 523	38	9.52 870	42	0.47 130	9.97 653	4	**20**
41	9.50 561	37	9.52 912	41	0.47 088	9.97 649	4	19
42	9.50 598	37	9.52 953	42	0.47 047	9.97 645	4	18
43	9.50 635	37	9.52 995	42	0.47 005	9.97 640	5	17
44	9.50 673	38	9.53 037	41	0.46 963	9.97 636	4	16
45	9.50 710	37	9.53 078	42	0.46 922	9.97 632	4	15
46	9.50 747	37	9.53 120	41	0.46 880	9.97 628	4	14
47	9.50 784	37	9.53 161	42	0.46 839	9.97 623	5	13
48	9.50 821	37	9.53 202	41	0.46 798	9.97 619	4	12
49	9.50 858	38	9.53 244	42	0.46 756	9.97 615	4	11
50	9.50 896	37	9.53 285	41	0.46 715	9.97 610	5	**10**
51	9.50 933	37	9.53 327	42	0.46 673	9.97 606	4	9
52	9.50 970	37	9.53 368	41	0.46 632	9.97 602	4	8
53	9.51 007	37	9.53 409	41	0.46 591	9.97 597	5	7
54	9.51 043	36	9.53 450	41	0.46 550	9.97 593	4	6
55	9.51 080	37	9.53 492	42	0.46 508	9.97 589	4	5
56	9.51 117	37	9.53 533	41	0.46 467	9.97 584	5	4
57	9.51 154	37	9.53 574	41	0.46 426	9.97 580	4	3
58	9.51 191	37	9.53 615	41	0.46 385	9.97 576	4	2
59	9.51 227	36	9.53 656	41	0.46 344	9.97 571	5	1
60	9.51 264	37	9.53 697	41	0.46 303	9.97 567	4	**0**
′	L. Cos.	d.	L. Cot.	c.d.	L. Tan.	L. Sin.	d	′

″	P. P.		
	43	**42**	**41**
1	0.7	0.7	0.7
2	1.4	1.4	1.4
3	2.2	2.1	2.0
4	2.9	2.8	2.7
5	3.6	3.5	3.4
6	4.3	4.2	4.1
7	5.0	4.9	4.8
8	5.7	5.6	5.5
9	6.4	6.3	6.2
10	7.2	7.0	6.8
20	14.3	14.0	13.7
30	21.5	21.0	20.5
40	28.7	28.0	27.3
50	35.8	35.0	34.2

″	**39**	**38**	**37**
1	0.6	0.6	0.6
2	1.3	1.3	1.2
3	2.0	1.9	1.8
4	2.6	2.5	2.5
5	3.2	3.2	3.1
6	3.9	3.8	3.7
7	4.6	4.4	4.3
8	5.2	5.1	4.9
9	5.8	5.7	5.6
10	6.5	6.3	6.2
20	13.0	12.7	12.3
30	19.5	19.0	18.5
40	26.0	25.3	24.7
50	32.5	31.7	30.8

″	**36**	**35**	**34**
1	0.6	0.1	0.1
2	1.2	0.2	0.1
3	1 8	0.2	0.2
4	2.4	0.3	0.3
5	3.0	0.4	0.3
6	3.6	0.5	0.4
7	4.2	0.6	0.5
8	4.8	0.7	0.5
9	5.4	0.8	0.6
10	6.0	0.8	0.7
20	12.0	1.7	1.3
30	18.0	2.5	2.0
40	24.0	3.3	2.7
50	30.0	4.2	3.3

	$\frac{5}{43}$	$\frac{5}{42}$	$\frac{5}{41}$
0	4.3	4.2	4.1
1	12.9	12.6	12.3
2	21.5	21.0	20.5
3	30.1	29.4	28.7
4	38.7	37.8	36.9

	$\frac{4}{43}$	$\frac{4}{42}$	$\frac{4}{41}$
0	5.4	5.2	5.1
1	16.1	15.8	15.4
2	26.9	26.2	25.6
3	37.6	36.8	35.9
4			

P. P.

108° (288°) (251°) 71°

19° (199°) (340°) **160°**

′	L. Sin.	d.	L. Tan.	c.d.	L. Cot.	L. Cos.	d.	′
0	9.51 264		9.53 697		0.46 303	9.97 567		**60**
1	9.51 301	37	9.53 738	41	0.46 262	9.97 563	4	59
2	9.51 338	37	9.53 779	41	0.46 221	9.97 558	5	58
3	9.51 374	36	9.53 820	41	0.46 180	9.97 554	4	57
4	9.51 411	37	9.53 861	41	0.46 139	9.97 550	4	56
5	9.51 447	36	9.53 902	41	0.46 098	9.97 545	5	55
6	9.51 484	37	9.53 943	41	0.46 057	9.97 541	4	54
7	9.51 520	37	9.53 984	41	0.46 016	9.97 536	5	53
8	9.51 557	37	9.54 025	41	0.45 975	9.97 532	4	52
9	9.51 593	36	9.54 065	40	0.45 935	9.97 528	4	51
10	9.51 629	36	9.54 106	41	0.45 894	9.97 523	5	**50**
11	9.51 666	37	9.54 147	41	0.45 853	9.97 519	4	49
12	9.51 702	36	9.54 187	40	0.45 813	9.97 515	4	48
13	9.51 738	36	9.54 228	41	0.45 772	9.97 510	5	47
14	9.51 774	36	9.54 269	41	0.45 731	9.97 506	4	46
15	9.51 811	37	9.54 309	40	0.45 691	9.97 501	5	45
16	9.51 847	36	9.54 350	41	0.45 650	9.97 497	4	44
17	9.51 883	36	9.54 390	40	0.45 610	9.97 492	5	43
18	9.51 919	36	9.54 431	41	0.45 569	9.97 488	4	42
19	9.51 955	36	9.54 471	40	0.45 529	9.97 484	4	41
20	9.51 991	36	9.54 512	41	0.45 488	9.97 479	5	**40**
21	9 52 027	36	9.54 552	40	0.45 448	9.97 475	4	39
22	9.52 063	36	9.54 593	41	0.45 407	9.97 470	5	38
23	9.52 099	36	9.54 633	40	0.45 367	9.97 466	4	37
24	9.52 135	36	9.54 673	40	0.45 327	9.97 461	5	36
25	9.52 171	36	9.54 714	41	0.45 286	9.97 457	4	35
26	9.52 207	36	9.54 754	40	0.45 246	9.97 453	4	34
27	9.52 242	35	9.54 794	40	0.45 206	9.97 448	5	33
28	9.52 278	36	9.54 835	41	0.45 165	9.97 444	4	32
29	9.52 314	36	9.54 875	40	0.45 125	9.97 439	5	31
30	9.52 350	36	9.54 915	40	0.45 085	9.97 435	4	**30**
31	9.52 385	35	9.54 955	40	0.45 045	9.97 430	5	29
32	9.52 421	36	9.54 995	40	0.45 005	9.97 426	4	28
33	9.52 456	35	9.55 035	40	0.44 965	9.97 421	5	27
34	9.52 492	36	9.55 075	40	0.44 925	9.97 417	4	26
35	9.52 527	35	9.55 115	40	0.44 885	9.97 412	5	25
36	9.52 563	36	9.55 155	40	0.44 845	9.97 408	4	24
37	9.52 598	35	9.55 195	40	0.44 805	9.97 403	5	23
38	9.52 634	36	9.55 235	40	0.44 765	9.97 399	4	22
39	9.52 669	35	9.55 275	40	0.44 725	9.97 394	5	21
40	9.52 705	36	9.55 315	40	0.44 685	9.97 390	4	**20**
41	9.52 740	35	9.55 355	40	0.44 645	9.97 385	5	19
42	9.52 775	35	9.55 395	40	0.44 605	9.97 381	4	18
43	9.52 811	36	9.55 434	39	0.44 566	9.97 376	5	17
44	9.52 846	35	9.55 474	40	0.44 526	9.97 372	4	16
45	9.52 881	35	9.55 514	40	0.44 486	9.97 367	5	15
46	9.52 916	35	9.55 554	40	0.44 446	9.97 363	4	14
47	9.52 951	35	9.55 593	39	0.44 407	9.97 358	5	13
48	9.52 986	35	9.55 633	40	0.44 367	9.97 353	5	12
49	9.53 021	35	9.55 673	40	0.44 327	9.97 349	4	11
50	9.53 056	35	9.55 712	39	0.44 288	9.97 344	5	**10**
51	9.53 092	36	9.55 752	40	0.44 248	9.97 340	4	9
52	9.53 126	34	9.55 791	39	0.44 209	9.97 335	5	8
53	9.53 161	35	9.55 831	40	0.44 169	9.97 331	4	7
54	9.53 196	35	9.55 870	39	0.44 130	9.97 326	5	6
55	9.53 231	35	9.55 910	40	0.44 090	9.97 322	4	5
56	9 53 266	35	9.55 949	39	0.44 051	9.97 317	5	4
57	9.53 301	35	9.55 989	40	0.44 011	9.97 312	5	3
58	9.53 336	35	9.56 028	39	0.43 972	9.97 308	4	2
59	9.53 370	34	9.56 067	39	0.43 933	9.97 303	5	1
60	9 53 405	35	9.56 107	40	0.43 893	9.97 299	4	**0**
′	L. Cos.	d.	L. Cot.	c.d.	L. Tan.	L. Sin.	d.	′

	P. P.		
″	**41**	**40**	**39**
1	0.7	0.7	0.6
2	1.4	1.3	1.3
3	2.0	2.0	2.0
4	2.7	2.7	2.6
5	3.4	3.3	3.2
6	4.1	4.0	3.9
7	4.8	4.7	4.6
8	5.5	5.3	5.2
9	6.2	6.0	5.8
10	6.8	6.7	6.5
20	13.7	13.3	13.0
30	20.5	20.0	19.5
40	27.3	26.7	26.0
50	34.2	33.3	32.5

″	**37**	**36**	**35**
1	0.6	0.6	0.6
2	1.2	1.2	1.2
3	1.8	1.8	1.8
4	2.5	2.4	2.3
5	3.1	3.0	2.9
6	3.7	3.6	3.5
7	4.3	4.2	4.1
8	4.9	4.8	4.7
9	5.6	5.4	5.2
10	6.2	6.0	5.8
20	12.3	12.0	11.7
30	18.5	18.0	17.5
40	24.7	24.0	23.3
50	30.8	30.0	29.2

″	**34**	**5**	**4**
1	0.6	0.1	0.1
2	1.1	0.2	0.1
3	1.7	0.2	0.2
4	2.3	0.3	0.3
5	2.8	0.4	0.3
6	3.4	0.5	0.4
7	4.0	0.6	0.5
8	4.5	0.7	0.5
9	5.1	0.8	0.6
10	5.7	0.8	0.7
20	11.3	1.7	1.3
30	17.0	2.5	2.0
40	22.7	3.3	2.7
50	28.3	4.2	3.3

	$\frac{5}{41}$	$\frac{5}{40}$	$\frac{5}{39}$
0	4.1	4.0	3.9
1	12.3	12.0	11.7
2	20.5	20.0	19.5
3	28.7	28.0	27.3
4	36.9	36.0	35.1

	$\frac{4}{41}$	$\frac{4}{40}$	$\frac{4}{39}$
0	5.1	5.0	4.9
1	15.4	15.0	14.6
2	25.6	25.0	24.4
3	35.9	35.0	34.1
4			

′	P. P.

109° (289°) (250°) **70°**

20° (200°) (339°) **159°**

′	L. Sin.	d.	L. Tan.	c.d.	L. Cot.	L. Cos.	d.	′
0	9.53 405		9.56 107		0.43 893	9.97 299		**60**
1	9.53 440	35	9.56 146	39	0.43 854	9.97 294	5	59
2	9.53 475	35	9.56 185	39	0.43 815	9.97 289	5	58
3	9.53 509	34	9.56 224	39	0.43 776	9.97 285	4	57
4	9.53 544	35	9.56 264	40	0.43 736	9.97 280	5	56
5	9.53 578	34	9.56 303	39	0.43 697	9.97 276	4	55
6	9.53 613	35	9.56 342	39	0.43 658	9.97 271	5	54
7	9.53 647	34	9.56 381	39	0.43 619	9.97 266	5	53
8	9.53 682	35	9.56 420	39	0.43 580	9.97 262	4	52
9	9.53 716	34	9.56 459	39	0.43 541	9.97 257	5	51
10	9.53 751	35	9.56 498	39	0.43 502	9.97 252	5	**50**
11	9.53 785	34	9.56 537	39	0.43 463	9.97 248	4	49
12	9.53 819	34	9.56 576	39	0.43 424	9.97 243	5	48
13	9.53 854	35	9.56 615	39	0.43 385	9.97 238	5	47
14	9.53 888	34	9.56 654	39	0.43 346	9.97 234	4	46
15	9.53 922	34	9.56 693	39	0.43 307	9.97 229	5	45
16	9.53 957	35	9.56 732	39	0.43 268	9.97 224	5	44
17	9.53 991	34	9.56 771	39	0.43 229	9.97 220	4	43
18	9.54 025	34	9.56 810	39	0.43 190	9.97 215	5	42
19	9.54 059	34	9.56 849	39	0.43 151	9.97 210	5	41
20	9.54 093	34	9.56 887	38	0.43 113	9.97 206	4	**40**
21	9.54 127	34	9.56 926	39	0.43 074	9.97 201	5	39
22	9.54 161	34	9.56 965	39	0.43 035	9.97 196	5	38
23	9.54 195	34	9.57 004	39	0.42 996	9.97 192	4	37
24	9.54 229	34	9.57 042	38	0.42 958	9.97 187	5	36
25	9.54 263	34	9.57 081	39	0.42 919	9.97 182	5	35
26	9.54 297	34	9.57 120	39	0.42 880	9.97 178	4	34
27	9.54 331	34	9.57 158	38	0.42 842	9.97 173	5	33
28	9.54 365	34	9.57 197	39	0.42 803	9.97 168	5	32
29	9.54 399	34	9.57 235	38	0.42 765	9.97 163	5	31
30	9.54 433	33	9.57 274	39	0.42 726	9.97 159	4	**30**
31	9.54 466	34	9.57 312	38	0.42 688	9.97 154	5	29
32	9.54 500	34	9.57 351	39	0.42 649	9.97 149	5	28
33	9.54 534	34	9.57 389	38	0.42 611	9.97 145	4	27
34	9.54 567	33	9.57 428	39	0.42 572	9.97 140	5	26
35	9.54 601	34	9.57 466	38	0.42 534	9.97 135	5	25
36	9.54 635	33	9.57 504	38	0.42 496	9.97 130	5	24
37	9.54 668	34	9.57 543	39	0.42 457	9.97 126	4	23
38	9.54 702	34	9.57 581	38	0.42 419	9.97 121	5	22
39	9.54 735	33	9.57 619	38	0.42 381	9.97 116	5	21
40	9.54 769	34	9.57 658	39	0.42 342	9.97 111	5	**20**
41	9.54 802	33	9.57 696	38	0.42 304	9.97 107	4	19
42	9.54 836	34	9.57 734	38	0.42 266	9.97 102	5	18
43	9.54 869	33	9.57 772	38	0.42 228	9.97 097	5	17
44	9.54 903	34	9.57 810	38	0.42 190	9.97 092	5	16
45	9.54 936	33	9.57 849	39	0.42 151	9.97 087	5	15
46	9.54 969	33	9.57 887	38	0.42 113	9.97 083	4	14
47	9.55 003	34	9.57 925	38	0.42 075	9.97 078	5	13
48	9.55 036	33	9.57 963	38	0.42 037	9.97 073	5	12
49	9.55 069	33	9.58 001	38	0.41 999	9.97 068	5	11
50	9.55 102	33	9.58 039	38	0.41 961	9.97 063	4	**10**
51	9.55 136	34	9.58 077	38	0.41 923	9.97 059	5	9
52	9.55 169	33	9.58 115	38	0.41 885	9.97 054	5	8
53	9.55 202	33	9.58 153	38	0.41 847	9.97 049	5	7
54	9.55 235	33	9.58 191	38	0.41 809	9.97 044	5	6
55	9.55 268	33	9.58 229	38	0.41 771	9.97 039	5	5
56	9.55 301	33	9.58 267	37	0.41 733	9.97 035	4	4
57	9.55 334	33	9.58 304	38	0.41 696	9.97 030	5	3
58	9.55 367	33	9.58 342	38	0.41 658	9.97 025	5	2
59	9.55 400	33	9.58 380	38	0.41 620	9.97 020	5	1
60	9.55 433	33	9.58 418	38	0.41 582	9.97 015	5	**0**
′	L. Cos.	d.	L. Cot.	c.d.	L. Tan.	L. Sin.	d.	′

P.P.			
″	**40**	**39**	**38**
1	0.7	0.6	0.6
2	1.3	1.3	1.3
3	2.0	2.0	1.9
4	2.7	2.6	2.5
5	3.3	3.2	3.2
6	4.0	3.9	3.8
7	4.7	4.6	4.4
8	5.3	5.2	5.1
9	6.0	5.8	5.7
10	6.7	6.5	6.3
20	13.3	13.0	12.7
30	20.0	19.5	19.0
40	26.7	26.0	25.3
50	33.3	32.5	31.7

P.P.			
″	**37**	**35**	**34**
1	0.6	0.6	0.6
2	1.2	1.2	1.1
3	1.8	1.8	1.7
4	2.5	2.3	2.3
5	3.1	2.9	2.8
6	3.7	3.5	3.4
7	4.3	4.1	4.0
8	4.9	4.7	4.5
9	5.6	5.2	5.1
10	6.2	5.8	5.7
20	12.3	11.7	11.3
30	18.5	17.5	17.0
40	24.7	23.3	22.7
50	30.8	29.2	28.3

P.P.			
″	**33**	**5**	**4**
1	0.6	0.1	0.1
2	1.1	0.2	0.1
3	1.6	0.2	0.2
4	2.2	0.3	0.3
5	2.8	0.4	0.3
6	3.3	0.5	0.4
7	3.8	0.6	0.5
8	4.4	0.7	0.5
9	5.0	0.8	0.6
10	5.5	0.8	0.7
20	11.0	1.7	1.3
30	16.5	2.5	2.0
40	22.0	3.3	2.7
50	27.5	4.2	3.3

	5 / **40**	**5** / **39**	**5** / **38**
0	4.0	3.9	3.8
1	12.0	11.7	11.4
2	20.0	19.5	19.0
3	28.0	27.3	26.6
4	36.0	35.1	34.2

	5 / **37**	**4** / **39**	**4** / **38**
0	3.7	4.9	4.8
1	11.1	14.6	14.2
2	18.5	24.4	23.8
3	25.9	34.1	33.2
4	33.3	—	—

110° (290°) (249°) **69°**

21° (201°) (338°) **158°**

′	L. Sin.	d.	L. Tan.	c.d.	L. Cot.	L. Cos.	d.	′
0	9.55 433		9.58 418		0.41 582	9.97 015		**60**
1	9.55 466	33	9.58 455	37	0.41 545	9.97 010	5	59
2	9.55 499	33	9.58 493	38	0.41 507	9.97 005	5	58
3	9.55 532	33	9.58 531	38	0.41 469	9.97 001	4	57
4	9.55 564	32	9.58 569	38	0.41 431	9.96 996	5	56
5	9.55 597	33	9.58 606	37	0.41 394	9.96 991	5	55
6	9.55 630	33	9.58 644	38	0.41 356	9.96 986	5	54
7	9.55 663	33	9.58 681	37	0.41 319	9.96 981	5	53
8	9.55 695	32	9.58 719	38	0.41 281	9.96 976	5	52
9	9.55 728	33	9.58 757	38	0.41 243	9.96 971	5	51
10	9.55 761	33	9.58 794	37	0.41 206	9.96 966	5	**50**
11	9.55 793	32	9.58 832	38	0.41 168	9.96 962	4	49
12	9.55 826	33	9.58 869	37	0.41 131	9.96 957	5	48
13	9.55 858	32	9.58 907	38	0.41 093	9.96 952	5	47
14	9.55 891	33	9.58 944	37	0.41 056	9.96 947	5	46
15	9.55 923	32	9.58 981	37	0.41 019	9.96 942	5	45
16	9.55 956	33	9.59 019	38	0.40 981	9.96 937	5	44
17	9.55 988	32	9.59 056	37	0.40 944	9.96 932	5	43
18	9.56 021	33	9.59 094	38	0.40 906	9.96 927	5	42
19	9.56 053	32	9.59 131	37	0.40 869	9.96 922	5	41
20	9.56 085	32	9.59 168	37	0.40 832	9.96 917	5	**40**
21	9.56 118	33	9.59 205	37	0.40 795	9.96 912	5	39
22	9.56 150	32	9.59 243	38	0.40 757	9.96 907	5	38
23	9.56 182	32	9.59 280	37	0.40 720	9.96 903	4	37
24	9.56 215	33	9.59 317	37	0.40 683	9.96 898	5	36
25	9.56 247	32	9.59 354	37	0.40 646	9.96 893	5	35
26	9.56 279	32	9.59 391	37	0.40 609	9.96 888	5	34
27	9.56 311	32	9.59 429	38	0.40 571	9.96 883	5	33
28	9.56 343	32	9.59 466	37	0.40 534	9.96 878	5	32
29	9.56 375	32	9.59 503	37	0.40 497	9.96 873	5	31
30	9.56 408	33	9.59 540	37	0.40 460	9.96 868	5	**30**
31	9.56 440	32	9.59 577	37	0.40 423	9.96 863	5	29
32	9.56 472	32	9.59 614	37	0.40 386	9.96 858	5	28
33	9.56 504	32	9.59 651	37	0.40 349	9.96 853	5	27
34	9.56 536	32	9.59 688	37	0.40 312	9.96 848	5	26
35	9.56 568	32	9.59 725	37	0.40 275	9.96 843	5	25
36	9.56 599	31	9.59 762	37	0.40 238	9.96 838	5	24
37	9.56 631	32	9.59 799	37	0.40 201	9.96 833	5	23
38	9.56 663	32	9.59 835	36	0.40 165	9.96 828	5	22
39	9.56 695	32	9.59 872	37	0.40 128	9.96 823	5	21
40	9.56 727	32	9.59 909	37	0.40 091	9.96 818	5	**20**
41	9.56 759	32	9.59 946	37	0.40 054	9.96 813	5	19
42	9.56 790	31	9.59 983	36	0.40 017	9.96 808	5	18
43	9.56 822	32	9.60 019	37	0.39 981	9.96 803	5	17
44	9.56 854	32	9.60 056	37	0.39 944	9.96 798	5	16
45	9.56 886	32	9.60 093	37	0.39 907	9.96 793	5	15
46	9.56 917	31	9.60 130	37	0.39 870	9.96 788	5	14
47	9.56 949	32	9.60 166	36	0.39 834	9.96 783	5	13
48	9.56 980	31	9.60 203	37	0.39 797	9.96 778	5	12
49	9.57 012	32	9.60 240	37	0.39 760	9.96 772	6	11
50	9.57 044	32	9.60 276	36	0.39 724	9.96 767	5	**10**
51	9.57 075	31	9.60 313	37	0.39 687	9.96 762	5	9
52	9.57 107	32	9.60 349	36	0.39 651	9.96 757	5	8
53	9.57 138	31	9.60 386	37	0.39 614	9.96 752	5	7
54	9.57 169	31	9.60 422	36	0.39 578	9.96 747	5	6
55	9.57 201	32	9.60 459	37	0.39 541	9.96 742	5	5
56	9.57 232	31	9.60 495	36	0.39 505	9.96 737	5	4
57	9.57 264	32	9.60 532	37	0.39 468	9.96 732	5	3
58	9.57 295	31	9.60 568	36	0.39 432	9.96 727	5	2
59	9.57 326	31	9.60 605	37	0.39 395	9.96 722	5	1
60	9.57 358	32	9.60 641	36	0.39 359	9.96 717	5	**0**
′	L. Cos.	d.	L. Cot.	c.d.	L. Tan.	L. Sin.	d.	′

P.P.			
″	**38**	**37**	**36**
1	0.6	0.6	0.6
2	1.3	1.2	1.2
3	1.9	1.8	1.8
4	2.5	2.5	2.4
5	3.2	3.1	3.0
6	3.8	3.7	3.6
7	4.4	4.3	4.2
8	5.1	4.9	4.8
9	5.7	5.6	5.4
10	6.3	6.2	6.0
20	12.7	12.3	12.0
30	19.0	18.5	18.0
40	25.3	24.7	24.0
50	31.7	30.8	30.0
″	**33**	**32**	**31**
1	0.6	0.5	0.5
2	1.1	1.1	1.0
3	1.6	1.6	1.6
4	2.2	2.1	2.1
5	2.8	2.7	2.6
6	3.3	3.2	3.1
7	3.8	3.7	3.6
8	4.4	4.3	4.1
9	5.0	4.8	4.6
10	5.5	5.3	5.2
20	11.0	10.7	10.3
30	16.5	16.0	15.5
40	22.0	21.3	20.7
50	27.5	26.7	25.8
″	**6**	**5**	**4**
1	0.1	0.1	0.1
2	0.2	0.2	0.1
3	0.3	0.2	0.2
4	0.4	0.3	0.3
5	0.5	0.4	0.3
6	0.6	0.5	0.4
7	0.7	0.6	0.5
8	0.8	0.7	0.5
9	0.9	0.8	0.6
10	1.0	0.8	0.7
20	2.0	1.7	1.3
30	3.0	2.5	2.0
40	4.0	3.3	2.7
50	5.0	4.2	3.3
	6	**5**	**5**
	37	**38**	**37**
0	3.1	3.8	3.7
1	9.2	11.4	11.1
2	15.4	19.0	18.5
3	21.6	26.6	25.9
4	27.8	34.2	33.3
5	33.9	—	—
6	**5**	**4**	**4**
	36	**38**	**37**
0	3.6	4.8	4.6
1	10.8	14.2	13.9
2	18.0	23.8	23.1
3	25.2	33.2	32.4
4	32.4	—	—
5			

P.P.

111° (291°) (248°) **68°**

22° (202°) (337°) **157°**

′	L. Sin.	d.	L. Tan.	c.d.	L. Cot.	L. Cos.	d.	′
0	9.57 358		9.60 641		0.39 359	9.96 717		**60**
1	9.57 389	31	9.60 677	36	0.39 323	9.96 711	6	59
2	9.57 420	31	9.60 714	37	0.39 286	9.96 706	5	58
3	9.57 451	31	9.60 750	36	0.39 250	9.96 701	5	57
4	9.57 482	31	9.60 786	36	0.39 214	9.96 696	5	56
5	9.57 514	32	9.60 823	37	0.39 177	9.96 691	5	55
6	9.57 545	31	9.60 859	36	0.39 141	9.96 686	5	54
7	9.57 576	31	9.60 895	36	0.39 105	9.96 681	5	53
8	9.57 607	31	9.60 931	36	0.39 069	9.96 676	5	52
9	9.57 638	31	9.60 967	37	0.39 033	9.96 670	6	51
10	9.57 669	31	9.61 004	36	0.38 996	9.96 665	5	**50**
11	9.57 700	31	9.61 040	36	0.38 960	9.96 660	5	49
12	9.57 731	31	9.61 076	36	0.38 924	9.96 655	5	48
13	9.57 762	31	9.61 112	36	0.38 888	9.96 650	5	47
14	9.57 793	31	9.61 148	36	0.38 852	9.96 645	5	46
15	9.57 824	31	9.61 184	36	0.38 816	9.96 640	6	45
16	9.57 855	31	9.61 220	36	0.38 780	9.96 634	5	44
17	9.57 885	30	9.61 256	36	0.38 744	9.96 629	5	43
18	9.57 916	31	9.61 292	36	0.38 708	9.96 624	5	42
19	9.57 947	31	9.61 328	36	0.38 672	9.96 619	5	41
20	9.57 978	30	9.61 364	36	0.38 636	9.96 614	6	**40**
21	9.58 008	31	9.61 400	36	0.38 600	9.96 608	5	39
22	9.58 039	31	9.61 436	36	0.38 564	9.96 603	5	38
23	9.58 070	31	9.61 472	36	0.38 528	9.96 598	5	37
24	9.58 101	30	9.61 508	36	0.38 492	9.96 593	5	36
25	9.58 131	31	9.61 544	35	0.38 456	9.96 588	6	35
26	9.58 162	30	9.61 579	36	0.38 421	9.96 582	5	34
27	9.58 192	31	9.61 615	36	0.38 385	9.96 577	5	33
28	9.58 223	30	9.61 651	36	0.38 349	9.96 572	5	32
29	9.58 253	31	9.61 687	35	0.38 313	9.96 567	5	31
30	9.58 284	30	9.61 722	36	0.38 278	9.96 562	6	**30**
31	9.58 314	31	9.61 758	36	0.38 242	9.96 556	5	29
32	9.58 345	30	9.61 794	36	0.38 206	9.96 551	5	28
33	9.58 375	31	9.61 830	36	0.38 170	9.96 546	5	27
34	9.58 406	31	9.61 865	35	0.38 135	9.96 541	6	26
35	9.58 436	30	9.61 901	36	0.38 099	9.96 535	5	25
36	9.58 467	31	9.61 936	35	0.38 064	9.96 530	5	24
37	9.58 497	30	9.61 972	36	0.38 028	9.96 525	5	23
38	9.58 527	30	9.62 008	36	0.37 992	9.96 520	5	22
39	9.58 557	30	9.62 043	35	0.37 957	9.96 514	6	21
40	9.58 588	30	9.62 079	36	0.37 921	9.96 509	5	**20**
41	9.58 618	30	9.62 114	35	0.37 886	9.96 504	5	19
42	9.58 648	30	9.62 150	36	0.37 850	9.96 498	6	18
43	9.58 678	30	9.62 185	35	0.37 815	9.96 493	5	17
44	9.58 709	31	9.62 221	36	0.37 779	9.96 488	5	16
45	9.58 739	30	9.62 256	35	0.37 744	9.96 483	6	15
46	9.58 769	30	9.62 292	36	0.37 708	9.96 477	6	14
47	9.58 799	30	9.62 327	35	0.37 673	9.96 472	5	13
48	9.58 829	30	9.62 362	35	0.37 638	9.96 467	5	12
49	9.58 859	30	9.62 398	36	0.37 602	9.96 461	6	11
50	9.58 889	30	9.62 433	35	0.37 567	9.96 456	5	**10**
51	9.58 919	30	9.62 468	35	0.37 532	9.96 451	5	9
52	9.58 949	30	9.62 504	36	0.37 496	9.96 445	6	8
53	9.58 979	30	9.62 539	35	0.37 461	9.96 440	5	7
54	9.59 009	30	9.62 574	35	0.37 426	9.96 435	5	6
55	9.59 039	30	9.62 609	35	0.37 391	9.96 429	6	5
56	9.59 069	30	9.62 645	36	0.37 355	9.96 424	5	4
57	9.59 098	29	9.62 680	35	0.37 320	9.96 419	5	3
58	9.59 128	30	9.62 715	35	0.37 285	9.96 413	6	2
59	9.59 158	30	9.62 750	35	0.37 250	9.96 408	5	1
60	9.59 188	30	9.62 785	35	0.37 215	9.96 403	5	**0**
′	L. Cos.	d.	L. Cot.	c.d.	L. Tan.	L. Sin.	d.	′

	P. P.		
″	**37**	**36**	**35**
1	0.6	0.6	0.6
2	1.2	1.2	1.2
3	1.8	1.8	1.8
4	2.5	2.4	2.3
5	3.1	3.0	2.9
6	3.7	3.6	3.5
7	4.3	4.2	4.1
8	4.9	4.8	4.7
9	5.6	5.4	5.2
10	6.2	6.0	5.8
20	12.3	12.0	11.7
30	18.5	18.0	17.5
40	24.7	24.0	23.3
50	30.8	30.0	29.2

	P. P.		
″	**32**	**31**	**30**
1	0.5	0.5	0.5
2	1.1	1.0	1.0
3	1.6	1.6	1.5
4	2.1	2.1	2.0
5	2.7	2.6	2.5
6	3.2	3.1	3.0
7	3.7	3.6	3.5
8	4.3	4.1	4.0
9	4.8	4.6	4.5
10	5.3	5.2	5.0
20	10.7	10.3	10.0
30	16.0	15.5	15.0
40	21.3	20.7	20.0
50	26.7	25.8	25.0

	P. P.		
″	**29**	**6**	**5**
1	0.5	0.1	0.1
2	1.0	0.2	0.2
3	1.4	0.3	0.2
4	1.9	0.4	0.3
5	2.4	0.5	0.4
6	2.9	0.6	0.5
7	3.4	0.7	0.6
8	3.9	0.8	0.7
9	4.4	0.9	0.8
10	4.8	1.0	0.8
20	9.7	2.0	1.7
30	14.5	3.0	2.5
40	19.3	4.0	3.3
50	24.2	5.0	4.2

	6 / **36**	**6** / **35**
0	3.0	2.9
1	9.0	8.8
2	15.0	14.6
3	21.0	20.4
4	27.0	26.2
5	33.0	32.1
6		

	5 / **37**	**5** / **36**	**5** / **3**
0	3.7	3.6	3.
1	11.1	10.8	10.
2	18.5	18.0	17.
3	25.9	25.2	24.
4	33.3	32.4	31.
5			

	P. P.

112° (292°) (247°) **67**

23° (203°) (336°) **156°**

′	L. Sin.	d.	L. Tan.	c.d.	L. Cot.	L. Cos.	d.	′
0	9.59 188		9.62 785		0.37 215	9.96 403		**60**
1	9.59 218	30	9.62 820	35	0.37 180	9.96 397	6	59
2	9.59 247	29	9.62 855	35	0.37 145	9.96 392	5	58
3	9.59 277	30	9.62 890	35	0.37 110	9.96 387	5	57
4	9.59 307	30	9.62 926	36	0.37 074	9.96 381	6	56
5	9.59 336	29	9.62 961	35	0.37 039	9.96 376	5	55
6	9.59 366	30	9.62 996	35	0.37 004	9.96 370	6	54
7	9.59 396	30	9.63 031	35	0.36 969	9.96 365	5	53
8	9.59 425	29	9.63 066	35	0.36 934	9.96 360	5	52
9	9.59 455	30	9.63 101	35	0.36 899	9.96 354	6	51
10	9.59 484	29	9.63 135	34	0.36 865	9.96 349	5	**50**
11	9.59 514	30	9.63 170	35	0.36 830	9.96 343	6	49
12	9.59 543	29	9.63 205	35	0.36 795	9.96 338	5	48
13	9.59 573	30	9.63 240	35	0.36 760	9.96 333	5	47
14	9.59 602	29	9.63 275	35	0.36 725	9.96 327	6	46
15	9.59 632	30	9.63 310	35	0.36 690	9.96 322	5	45
16	9.59 661	29	9.63 345	35	0.36 655	9.96 316	6	44
17	9.59 690	29	9.63 379	34	0.36 621	9.96 311	5	43
18	9.59 720	30	9.63 414	35	0.36 586	9.96 305	6	42
19	9.59 749	29	9.63 449	35	0.36 551	9.96 300	5	41
20	9.59 778	29	9.63 484	35	0.36 516	9.96 294	6	**40**
21	9.59 808	30	9.63 519	35	0.36 481	9.96 289	5	39
22	9.59 837	29	9.63 553	34	0.36 447	9.96 284	5	38
23	9.59 866	29	9.63 588	35	0.36 412	9.96 278	6	37
24	9.59 895	29	9.63 623	35	0.36 377	9.96 273	5	36
25	9.59 924	29	9.63 657	34	0.36 343	9.96 267	6	35
26	9.59 954	30	9.63 692	35	0.36 308	9.96 262	5	34
27	9.59 983	29	9.63 726	34	0.36 274	9.96 256	6	33
28	9.60 012	29	9.63 761	35	0.36 239	9.96 251	5	32
29	9.60 041	29	9.63 796	35	0.36 204	9.96 245	6	31
30	9.60 070	29	9.63 830	34	0.36 170	9.96 240	5	**30**
31	9.60 099	29	9.63 865	35	0.36 135	9.96 234	6	29
32	9.60 128	29	9.63 899	34	0.36 101	9.96 229	5	28
33	9.60 157	29	9.63 934	35	0.36 066	9.96 223	6	27
34	9.60 186	29	9.63 968	34	0.36 032	9.96 218	5	26
35	9.60 215	29	9.64 003	35	0.35 997	9.96 212	6	25
36	9.60 244	29	9.64 037	34	0.35 963	9.96 207	5	24
37	9.60 273	29	9.64 072	35	0.35 928	9.96 201	6	23
38	9.60 302	29	9.64 106	34	0.35 894	9.96 196	5	22
39	9.60 331	29	9.64 140	34	0.35 860	9.96 190	6	21
40	9.60 359	28	9.64 175	35	0.35 825	9.96 185	5	**20**
41	9.60 388	29	9.64 209	34	0.35 791	9.96 179	6	19
42	9.60 417	29	9.64 243	34	0.35 757	9.96 174	5	18
43	9.60 446	29	9.64 278	35	0.35 722	9.96 168	6	17
44	9.60 474	28	9.64 312	34	0.35 688	9.96 162	6	16
45	9.60 503	29	9.64 346	34	0.35 654	9.96 157	5	15
46	9.60 532	29	9.64 381	35	0.35 619	9.96 151	6	14
47	9.60 561	29	9.64 415	34	0.35 585	9.96 146	5	13
48	9.60 589	28	9.64 449	34	0.35 551	9.96 140	6	12
49	9.60 618	29	9.64 483	34	0.35 517	9.96 135	5	11
50	9.60 646	28	9.64 517	34	0.35 483	9.96 129	6	**10**
51	9.60 675	29	9.64 552	35	0.35 448	9.96 123	6	9
52	9.60 704	29	9.64 586	34	0.35 414	9.96 118	5	8
53	9.60 732	28	9.64 620	34	0.35 380	9.96 112	6	7
54	9.60 761	29	9.64 654	34	0.35 346	9.96 107	6	6
55	9.60 789	28	9.64 688	34	0.35 312	9.96 101	6	5
56	9.60 818	29	9.64 722	34	0.35 278	9.96 095	6	4
57	9.60 846	28	9.64 756	34	0.35 244	9.96 090	5	3
58	9.60 875	29	9.64 790	34	0.35 210	9.96 084	6	2
59	9.60 903	28	9.64 824	34	0.35 176	9.96 079	5	1
60	9.60 931	28	9.64 858	34	0.35 142	9.96 073	6	**0**
′	L. Cos.	d.	L. Cot.	c.d.	L. Tan.	L. Sin.	d.	′

P. P.			
″	**36**	**35**	**34**
1	0.6	0.6	0.6
2	1.2	1.2	1.1
3	1.8	1.8	1.7
4	2.4	2.3	2.3
5	3.0	2.9	2.8
6	3.6	3.5	3.4
7	4.2	4.1	4.0
8	4.8	4.7	4.5
9	5.4	5.2	5.1
10	6.0	5.8	5.7
20	12.0	11.7	11.3
30	18.0	17.5	17.0
40	24.0	23.3	22.7
50	30.0	29.2	28.3

″	**30**	**29**	**28**
1	0.5	0.5	0.5
2	1.0	1.0	0.9
3	1.5	1.4	1.4
4	2.0	1.9	1.9
5	2.5	2.4	2.3
6	3.0	2.9	2.8
7	3.5	3.4	3.3
8	4.0	3.9	3.7
9	4.5	4.4	4.2
10	5.0	4.8	4.7
20	10.0	9.7	9.3
30	15.0	14.5	14.0
40	20.0	19.3	18.7
50	25.0	24.2	23.3

″	**6**	**5**
1	0.1	0.1
2	0.2	0.2
3	0.3	0.2
4	0.4	0.3
5	0.5	0.4
6	0.6	0.5
7	0.7	0.6
8	0.8	0.7
9	0.9	0.8
10	1.0	0.8
20	2.0	1.7
30	3.0	2.5
40	4.0	3.3
50	5.0	4.2

	6 / **36**	**6** / **35**	**6** / **34**
0	3.0	2.9	2.8
1	9.0	8.8	8.5
2	15.0	14.6	14.2
3	21.0	20.4	19.8
4	27.0	26.2	25.5
5	33.0	32.1	31.2
6			

	5 / **35**	**5** / **34**
0	3.5	3.4
1	10.5	10.2
2	17.5	17.0
3	24.5	23.8
4	31.5	30.6
5		

P. P.

113° (293°) (246°) **66°**

24° (204°) (335°) **155°**

′	L. Sin.	d.	L. Tan.	c.d.	L. Cot.	L. Cos.	d.	′
0	9.60 931		9.64 858		0.35 142	9.96 073		**60**
1	9.60 960	29	9.64 892	34	0.35 108	9.96 067	6	59
2	9.60 988	28	9.64 926	34	0.35 074	9.96 062	5	58
3	9.61 016	28	9.64 960	34	0.35 040	9.96 056	6	57
4	9.61 045	29	9.64 994	34	0.35 006	9.96 050	6	56
5	9.61 073	28	9.65 028	34	0.34 972	9.96 045	5	55
6	9.61 101	28	9.65 062	34	0.34 938	9.96 039	6	54
7	9.61 129	28	9.65 096	34	0.34 904	9.96 034	5	53
8	9.61 158	29	9.65 130	34	0.34 870	9.96 028	6	52
9	9.61 186	28	9.65 164	34	0.34 836	9.96 022	6	51
10	9.61 214	28	9.65 197	33	0.34 803	9.96 017	5	**50**
11	9.61 242	28	9.65 231	34	0.34 769	9.96 011	6	49
12	9.61 270	28	9.65 265	34	0.34 735	9.96 005	6	48
13	9.61 298	28	9.65 299	34	0.34 701	9.96 000	5	47
14	9.61 326	28	9.65 333	34	0.34 667	9.95 994	6	46
15	9.61 354	28	9.65 366	33	0.34 634	9.95 988	6	45
16	9.61 382	28	9.65 400	34	0.34 600	9.95 982	6	44
17	9.61 411	29	9.65 434	34	0.34 566	9.95 977	5	43
18	9.61 438	27	9.65 467	33	0.34 533	9.95 971	6	42
19	9.61 466	28	9.65 501	34	0.34 499	9.95 965	6	41
20	9.61 494	28	9.65 535	34	0.34 465	9.95 960	5	**40**
21	9.61 522	28	9.65 568	33	0.34 432	9.95 954	6	39
22	9.61 550	28	9.65 602	34	0.34 398	9.95 948	6	38
23	9.61 578	28	9.65 636	34	0.34 364	9.95 942	6	37
24	9.61 606	28	9.65 669	33	0.34 331	9.95 937	5	36
25	9.61 634	28	9.65 703	34	0.34 297	9.95 931	6	35
26	9.61 662	28	9.65 736	33	0.34 264	9.95 925	6	34
27	9.61 689	27	9.65 770	34	0.34 230	9.95 920	5	33
28	9.61 717	28	9.65 803	33	0.34 197	9.95 914	6	32
29	9.61 745	28	9.65 837	34	0.34 163	9.95 908	6	31
30	9.61 773	27	9.65 870	33	0.34 130	9.95 902	6	**30**
31	9.61 800	28	9.65 904	34	0.34 096	9.95 897	5	29
32	9.61 828	28	9.65 937	33	0.34 063	9.95 891	6	28
33	9.61 856	27	9.65 971	34	0.34 029	9.95 885	6	27
34	9.61 883	28	9.66 004	33	0.33 996	9.95 879	6	26
35	9.61 911	28	9.66 038	34	0.33 962	9.95 873	6	25
36	9.61 939	28	9.66 071	33	0.33 929	9.95 868	5	24
37	9.61 966	27	9.66 104	33	0.33 896	9.95 862	6	23
38	9.61 994	28	9.66 138	34	0.33 862	9.95 856	6	22
39	9.62 021	27	9.66 171	33	0.33 829	9.95 850	6	21
40	9.62 049	28	9.66 204	33	0.33 796	9.95 844	6	**20**
41	9.62 076	27	9.66 238	34	0.33 762	9.95 839	5	19
42	9.62 104	28	9.66 271	33	0.33 729	9.95 833	6	18
43	9.62 131	27	9.66 304	33	0.33 696	9.95 827	6	17
44	9.62 159	28	9.66 337	33	0.33 663	9.95 821	6	16
45	9.62 186	27	9.66 371	34	0.33 629	9.95 815	6	15
46	9.62 214	28	9.66 404	33	0.33 596	9.95 810	5	14
47	9.62 241	27	9.66 437	33	0.33 563	9.95 804	6	13
48	9.62 268	27	9.66 470	33	0.33 530	9.95 798	6	12
49	9.62 296	28	9.66 503	33	0.33 497	9.95 792	6	11
50	9.62 323	27	9.66 537	34	0.33 463	9.95 786	6	**10**
51	9.62 350	27	9.66 570	33	0.33 430	9.95 780	6	9
52	9.62 377	27	9.66 603	33	0.33 397	9.95 775	5	8
53	9.62 405	28	9.66 636	33	0.33 364	9.95 769	6	7
54	9.62 432	27	9.66 669	33	0.33 331	9.95 763	6	6
55	9.62 459	27	9.66 702	33	0.33 298	9.95 757	6	5
56	9.62 486	27	9.66 735	33	0.33 265	9.95 751	6	4
57	9.62 513	27	9.66 768	33	0.33 232	9.95 745	6	3
58	9.62 541	28	9.66 801	33	0.33 199	9.95 739	6	2
59	9.62 568	27	9.66 834	33	0.33 166	9.95 733	6	1
60	9.62 595	27	9.66 867	33	0.33 133	9.95 728	5	**0**
′	L. Cos.	d.	L. Cot.	c.d.	L. Tan.	L. Sin.	d.	′

114° (294°) (245°) **65°**

P.P.

	34	33
1	0.6	0.6
2	1.1	1.1
3	1.7	1.6
4	2.3	2.2
5	2.8	2.8
6	3.4	3.3
7	4.0	3.8
8	4.5	4.4
9	5.1	5.0
10	5.7	5.5
20	11.3	11.0
30	17.0	16.5
40	22.7	22.0
50	28.3	27.5

	29	28	27
1	0.5	0.5	0.4
2	1.0	0.9	0.9
3	1.4	1.4	1.4
4	1.9	1.9	1.8
5	2.4	2.3	2.2
6	2.9	2.8	2.7
7	3.4	3.3	3.2
8	3.9	3.7	3.6
9	4.4	4.2	4.0
10	4.8	4.7	4.5
20	9.7	9.3	9.0
30	14.5	14.0	13.5
40	19.3	18.7	18.0
50	24.2	23.3	22.5

	6	5
1	0.1	0.1
2	0.2	0.2
3	0.3	0.2
4	0.4	0.3
5	0.5	0.4
6	0.6	0.5
7	0.7	0.6
8	0.8	0.7
9	0.9	0.8
10	1.0	0.8
20	2.0	1.7
30	3.0	2.5
40	4.0	3.3
50	5.0	4.2

	6/34	6/33	5/34
0			
1	2.8	2.8	3.4
2	8.5	8.2	10.2
3	14.2	13.8	17.0
4	19.8	19.2	23.8
5	25.5	24.8	30.6
6	31.2	30.2	

P.P.

25° (205°) (334°) **154°**

′	L. Sin.	d.	L. Tan.	c.d.	L. Cot.	L. Cos.	d.	′
0	9.62 595		9.66 867		0.33 133	9.95 728		**60**
1	9.62 622	27	9.66 900	33	0.33 100	9.95 722	6	59
2	9.62 649	27	9.66 933	33	0.33 067	9.95 716	6	58
3	9.62 676	27	9.66 966	33	0.33 034	9.95 710	6	57
4	9.62 703	27	9.66 999	33	0.33 001	9.95 704	6	56
5	9.62 730	27	9.67 032	33	0.32 968	9.95 698	6	55
6	9.62 757	27	9.67 065	33	0.32 935	9.95 692	6	54
7	9.62 784	27	9.67 098	33	0.32 902	9.95 686	6	53
8	9.62 811	27	9.67 131	33	0.32 869	9.95 680	6	52
9	9.62 838	27	9.67 163	32	0.32 837	9.95 674	6	51
10	9.62 865		9.67 196	33	0.32 804	9.95 668	6	**50**
11	9.62 892	27	9.67 229	33	0.32 771	9.95 663	5	49
12	9.62 918	26	9.67 262	33	0.32 738	9.95 657	6	48
13	9.62 945	27	9.67 295	33	0.32 705	9.95 651	6	47
14	9.62 972	27	9.67 327	32	0.32 673	9.95 645	6	46
15	9.62 999	27	9.67 360	33	0.32 640	9.95 639	6	45
16	9.63 026	27	9.67 393	33	0.32 607	9.95 633	6	44
17	9.63 052	26	9.67 426	33	0.32 574	9.95 627	6	43
18	9.63 079	27	9.67 458	32	0.32 542	9.95 621	6	42
19	9.63 106	27	9.67 491	33	0.32 509	9.95 615	6	41
20	9.63 133		9.67 524	33	0.32 476	9.95 609	6	**40**
21	9.63 159	26	9.67 556	32	0.32 444	9.95 603	6	39
22	9.63 186	27	9.67 589	33	0.32 411	9.95 597	6	38
23	9.63 213	27	9.67 622	33	0.32 378	9.95 591	6	37
24	9.63 239	26	9.67 654	32	0.32 346	9.95 585	6	36
25	9.63 266	27	9.67 687	33	0.32 313	9.95 579	6	35
26	9.63 292	26	9.67 719	32	0.32 281	9.95 573	6	34
27	9.63 319	27	9.67 752	33	0.32 248	9.95 567	6	33
28	9.63 345	26	9.67 785	33	0.32 215	9.95 561	6	32
29	9.63 372	27	9.67 817	32	0.32 183	9.95 555	6	31
30	9.63 398	26	9.67 850	33	0.32 150	9.95 549	6	**30**
31	9.63 425	27	9.67 882	32	0.32 118	9.95 543	6	29
32	9.63 451	26	9.67 915	33	0.32 085	9.95 537	6	28
33	9.63 478	27	9.67 947	32	0.32 053	9.95 531	6	27
34	9.63 504	26	9.67 980	33	0.32 020	9.95 525	6	26
35	9.63 531	27	9.68 012	32	0.31 988	9.95 519	6	25
36	9.63 557	26	9.68 044	32	0.31 956	9.95 513	6	24
37	9.63 583	26	9.68 077	33	0.31 923	9.95 507	6	23
38	9.63 610	27	9.68 109	32	0.31 891	9.95 500	7	22
39	9.63 636	26	9.68 142	33	0.31 858	9.95 494	6	21
40	9.63 662	26	9.68 174	32	0.31 826	9.95 488	6	**20**
41	9.63 689	27	9.68 206	32	0.31 794	9.95 482	6	19
42	9.63 715	26	9.68 239	33	0.31 761	9.95 476	6	18
43	9.63 741	26	9.68 271	32	0.31 729	9.95 470	6	17
44	9.63 767	26	9.68 303	32	0.31 697	9.95 464	6	16
45	9.63 794	27	9.68 336	33	0.31 664	9.95 458	6	15
46	9.63 820	26	9.68 368	32	0.31 632	9.95 452	6	14
47	9.63 846	26	9.68 400	32	0.31 600	9.95 446	6	13
48	9.63 872	26	9.68 432	32	0.31 568	9.95 440	6	12
49	9.63 898	26	9.68 465	33	0.31 535	9.95 434	6	11
50	9.63 924	26	9.68 497	32	0.31 503	9.95 427	7	**10**
51	9.63 950	26	9.68 529	32	0.31 471	9.95 421	6	9
52	9.63 976	26	9.68 561	32	0.31 439	9.95 415	6	8
53	9.64 002	26	9.68 593	32	0.31 407	9.95 409	6	7
54	9.64 028	26	9.68 626	33	0.31 374	9.95 403	6	6
55	9.64 054	26	9.68 658	32	0.31 342	9.95 397	6	5
56	9.64 080	26	9.68 690	32	0.31 310	9.95 391	6	4
57	9.64 106	26	9.68 722	32	0.31 278	9.95 384	7	3
58	9.64 132	26	9.68 754	32	0.31 246	9.95 378	6	2
59	9.64 158	26	9.68 786	32	0.31 214	9.95 372	6	1
60	9.64 184	26	9.68 818	32	0.31 182	9.95 366	6	**0**
′	L. Cos.	d.	L. Cot.	c.d.	L. Tan.	L. Sin.	d.	′

P.P.

	33	32
1	0.6	0.5
2	1.1	1.1
3	1.6	1.6
4	2.2	2.1
5	2.8	2.7
6	3.3	3.2
7	3.8	3.7
8	4.4	4.3
9	5.0	4.8
10	5.5	5.3
20	11.0	10.7
30	16.5	16.0
40	22.0	21.3
50	27.5	26.7

	27	26
1	0.4	0.4
2	0.9	0.9
3	1.4	1.3
4	1.8	1.7
5	2.2	2.2
6	2.7	2.6
7	3.2	3.0
8	3.6	3.5
9	4.0	3.9
10	4.5	4.3
20	9.0	8.7
30	13.5	13.0
40	18.0	17.3
50	22.5	21.7

	7	6	5
1	0.1	0.1	0.1
2	0.2	0.2	0.2
3	0.4	0.3	0.2
4	0.5	0.4	0.3
5	0.6	0.5	0.4
6	0.7	0.6	0.5
7	0.8	0.7	0.6
8	0.9	0.8	0.7
9	1.0	0.9	0.8
10	1.2	1.0	0.8
20	2.3	2.0	1.7
30	3.5	3.0	2.5
40	4.7	4.0	3.3
50	5.8	5.0	4.2

	7/32	6/32	5/33
0	2.3	2.7	3.3
1	6.9	8.0	9.9
2	11.4	13.3	16.5
3	16.0	18.7	23.1
4	20.6	24.0	29.7
5	25.1	29.3	—
6	29.7	—	—
7			

P.P.

115° (295°) (244°) **64°**

26° (206°) (333°) **153°**

′	L. Sin.	d.	L. Tan.	c.d.	L. Cot.	L. Cos.	d.	′
0	9.64 184		9.68 818		0.31 182	9.95 366		**60**
1	9.64 210	26	9.68 850	32	0.31 150	9.95 360	6	59
2	9.64 236	26	9.68 882	32	0.31 118	9.95 354	6	58
3	9.64 262	26	9.68 914	32	0.31 086	9.95 348	6	57
4	9.64 288	26	9.68 946	32	0.31 054	9.95 341	7	56
5	9.64 313	25	9.68 978	32	0.31 022	9.95 335	6	55
6	9.64 339	26	9.69 010	32	0.30 990	9.95 329	6	54
7	9.64 365	26	9.69 042	32	0.30 958	9.95 323	6	53
8	9.64 391	26	9.69 074	32	0.30 926	9.95 317	6	52
9	9.64 417	26	9.69 106	32	0.30 894	9.95 310	7	51
10	9.64 442	25	9.69 138	32	0.30 862	9.95 304	6	**50**
11	9.64 468	26	9.69 170	32	0.30 830	9.95 298	6	49
12	9.64 494	26	9.69 202	32	0.30 798	9.95 292	6	48
13	9.64 519	25	9.69 234	32	0.30 766	9.95 286	6	47
14	9.64 545	26	9.69 266	32	0.30 734	9.95 279	7	46
15	9.64 571	26	9.69 298	31	0.30 702	9.95 273	6	45
16	9.64 596	25	9.69 329	32	0.30 671	9.95 267	6	44
17	9.64 622	26	9.69 361	32	0.30 639	9.95 261	6	43
18	9.64 647	25	9.69 393	32	0.30 607	9.95 254	7	42
19	9.64 673	26	9.69 425	32	0.30 575	9.95 248	6	41
20	9.64 698	25	9.69 457	31	0.30 543	9.95 242	6	**40**
21	9.64 724	26	9.69 488	32	0.30 512	9.95 236	6	39
22	9.64 749	25	9.69 520	32	0.30 480	9.95 229	7	38
23	9.64 775	26	9.69 552	32	0.30 448	9.95 223	6	37
24	9.64 800	25	9.69 584	32	0.30 416	9.95 217	6	36
25	9.64 826	26	9.69 615	31	0.30 385	9.95 211	6	35
26	9.64 851	25	9.69 647	32	0.30 353	9.95 204	7	34
27	9.64 877	26	9.69 679	32	0.30 321	9.95 198	6	33
28	9.64 902	25	9.69 710	31	0.30 290	9.95 192	6	32
29	9.64 927	25	9.69 742	32	0.30 258	9.95 185	7	31
30	9.64 953	26	9.69 774	31	0.30 226	9.95 179	6	**30**
31	9.64 978	25	9.69 805	32	0.30 195	9.95 173	6	29
32	9.65 003	25	9.69 837	31	0.30 163	9.95 167	6	28
33	9.65 029	26	9.69 868	32	0.30 132	9.95 160	7	27
34	9.65 054	25	9.69 900	32	0.30 100	9.95 154	6	26
35	9.65 079	25	9.69 932	31	0.30 068	9.95 148	6	25
36	9.65 104	25	9.69 963	31	0.30 037	9.95 141	7	24
37	9.65 130	26	9.69 995	32	0.30 005	9.95 135	6	23
38	9.65 155	25	9.70 026	31	0.29 974	9.95 129	6	22
39	9.65 180	25	9.70 058	32	0.29 942	9.95 122	7	21
40	9.65 205	25	9.70 089	31	0.29 911	9.95 116	6	**20**
41	9.65 230	25	9.70 121	32	0.29 879	9.95 110	6	19
42	9.65 255	25	9.70 152	31	0.29 848	9.95 103	7	18
43	9.65 281	26	9.70 184	32	0.29 816	9.95 097	6	17
44	9.65 306	25	9.70 215	31	0.29 785	9.95 090	7	16
45	9.65 331	25	9.70 247	32	0.29 753	9.95 084	6	15
46	9.65 356	25	9.70 278	31	0.29 722	9.95 078	6	14
47	9.65 381	25	9.70 309	31	0.29 691	9.95 071	7	13
48	9.65 406	25	9.70 341	32	0.29 659	9.95 065	6	12
49	9.65 431	25	9.70 372	31	0.29 628	9.95 059	6	11
50	9.65 456	25	9.70 404	32	0.29 596	9.95 052	7	**10**
51	9.65 481	25	9.70 435	31	0.29 565	9.95 046	6	9
52	9.65 506	25	9.70 466	31	0.29 534	9.95 039	7	8
53	9.65 531	25	9.70 498	32	0.29 502	9.95 033	6	7
54	9.65 556	25	9.70 529	31	0.29 471	9.95 027	6	6
55	9.65 580	24	9.70 560	31	0.29 440	9.95 020	7	5
56	9.65 605	25	9.70 592	32	0.29 408	9.95 014	6	4
57	9.65 630	25	9.70 623	31	0.29 377	9.95 007	7	3
58	9.65 655	25	9.70 654	31	0.29 346	9.95 001	6	2
59	9.65 680	25	9.70 685	31	0.29 315	9.94 995	6	1
60	9.65 705	25	9.70 717	32	0.29 283	9.94 988	7	**0**
′	L. Cos.	d.	L. Cot.	c.d.	L. Tan.	L. Sin.	d.	′

P.P.

#	32	31
1	0.5	0.5
2	1.1	1.0
3	1.6	1.6
4	2.1	2.1
5	2.7	2.6
6	3.2	3.1
7	3.7	3.6
8	4.3	4.1
9	4.8	4.6
10	5.3	5.2
20	10.7	10.3
30	16.0	15.5
40	21.3	20.7
50	26.7	25.8

#	26	25	24
1	0.4	0.4	0.4
2	0.9	0.8	0.8
3	1.3	1.2	1.2
4	1.7	1.7	1.6
5	2.2	2.1	2.0
6	2.6	2.5	2.4
7	3.0	2.9	2.8
8	3.5	3.3	3.2
9	3.9	3.8	3.6
10	4.3	4.2	4.0
20	8.7	8.3	8.0
30	13.0	12.5	12.0
40	17.3	16.7	16.0
50	21.7	20.8	20.0

#	7	6
1	0.1	0.1
2	0.2	0.2
3	0.4	0.3
4	0.5	0.4
5	0.6	0.5
6	0.7	0.6
7	0.8	0.7
8	0.9	0.8
9	1.0	0.9
10	1.2	1.0
20	2.3	2.0
30	3.5	3.0
40	4.7	4.0
50	5.8	5.0

#	7/32	7/31	6/32
0	2.3	2.2	2.7
1	6.9	6.6	8.0
2	11.4	11.1	13.3
3	16.0	15.5	18.7
4	20.6	19.9	24.0
5	25.1	24.4	29.3
6	29.7	28.8	—
7			

P.P.

116° (296°) (243°) **63°**

27° (207°) (332°) **152°**

′	L. Sin.	d.	L. Tan.	c.d.	L. Cot.	L. Cos.	d.	′
0	9.65 705		9.70 717		0.29 283	9.94 988		**60**
1	9.65 729	24	9.70 748	31	0.29 252	9.94 982	6	59
2	9.65 754	25	9.70 779	31	0.29 221	9.94 975	7	58
3	9.65 779	25	9.70 810	31	0.29 190	9.94 969	6	57
4	9.65 804	25	9.70 841	31	0.29 159	9.94 962	7	56
5	9.65 828	24	9.70 873	32	0.29 127	9.94 956	6	55
6	9.65 853	25	9.70 904	31	0.29 096	9.94 949	7	54
7	9.65 878	25	9.70 935	31	0.29 065	9.94 943	6	53
8	9.65 902	24	9.70 966	31	0.29 031	9.94 936	7	52
9	9.65 927	25	9.70 997	31	0.29 003	9.94 930	6	51
10	9.65 952	25	9.71 028	31	0.28 972	9.94 923	7	**50**
11	9.65 976	24	9.71 059	31	0.28 941	9.94 917	6	49
12	9.66 001	25	9.71 090	31	0.28 910	9.94 911	6	48
13	9.66 025	24	9.71 121	32	0.28 879	9.94 904	7	47
14	9.66 050	25	9.71 153	31	0.28 847	9.94 898	6	46
15	9.66 075	25	9.71 184	31	0.28 816	9.94 891	7	45
16	9.66 099	24	9.71 215	31	0.28 785	9.94 885	6	44
17	9.66 124	25	9.71 246	31	0.28 754	9.94 878	7	43
18	9.66 148	24	9.71 277	31	0.28 723	9.94 871	7	42
19	9.66 173	25	9.71 308	31	0.28 692	9.94 865	7	41
20	9.66 197	24	9.71 339	31	0.28 661	9.94 858	7	**40**
21	9.66 221	24	9.71 370	31	0.28 630	9.94 852	6	39
22	9.66 246	25	9.71 401	30	0.28 599	9.94 845	7	38
23	9.66 270	24	9.71 431	31	0.28 569	9.94 839	6	37
24	9.66 295	25	9.71 462	31	0.28 538	9.94 832	7	36
25	9.66 319	24	9.71 493	31	0.28 507	9.94 826	6	35
26	9.66 343	24	9.71 524	31	0.28 476	9.94 819	7	34
27	9.66 368	25	9.71 555	31	0.28 445	9.94 813	6	33
28	9.66 392	24	9.71 586	31	0.28 414	9.94 806	7	32
29	9.66 416	24	9.71 617	31	0.28 383	9.94 799	7	31
30	9.66 441	25	9.71 648	31	0.28 352	9.94 793	6	**30**
31	9.66 465	24	9.71 679	30	0.28 321	9.94 786	7	29
32	9.66 489	24	9.71 709	31	0.28 291	9.94 780	6	28
33	9.66 513	24	9.71 740	31	0.28 260	9.94 773	7	27
34	9.66 537	24	9.71 771	31	0.28 229	9.94 767	6	26
35	9.66 562	25	9.71 802	31	0.28 198	9.94 760	7	25
36	9.66 586	24	9.71 833	31	0.28 167	9.94 753	7	24
37	9.66 610	24	9.71 863	30	0.28 137	9.94 747	6	23
38	9.66 634	24	9.71 894	31	0.28 106	9.94 740	7	22
39	9.66 658	24	9.71 925	31	0.28 075	9.94 734	6	21
40	9.66 682	24	9.71 955	30	0.28 045	9.94 727	7	**20**
41	9.66 706	24	9.71 986	31	0.28 014	9.94 720	7	19
42	9.66 731	25	9.72 017	31	0.27 983	9.94 714	6	18
43	9.66 755	24	9.72 048	31	0.27 952	9.94 707	7	17
44	9.66 779	24	9.72 078	30	0.27 922	9.94 700	7	16
45	9.66 803	24	9.72 109	31	0.27 891	9.94 694	6	15
46	9.66 827	24	9.72 140	31	0.27 860	9.94 687	7	14
47	9.66 851	24	9.72 170	30	0.27 830	9.94 680	7	13
48	9.66 875	24	9.72 201	31	0.27 799	9.94 674	6	12
49	9.66 899	24	9.72 231	30	0.27 769	9.94 667	7	11
50	9.66 922	23	9.72 262	31	0.27 738	9.94 660	7	**10**
51	6.66 946	24	9.72 293	31	0.27 707	9.94 654	6	9
52	8.66 970	24	9.72 323	30	0.27 677	9.94 647	7	8
53	9.66 994	24	9.72 354	31	0.27 646	9.94 640	7	7
54	9.67 018	24	9.72 384	30	0.27 616	9.94 634	6	6
55	9.67 042	24	9.72 415	31	0.27 585	9.94 627	7	5
56	9.67 066	24	9.72 445	30	0 27 555	9.94 620	7	4
57	9.67 090	24	9.72 476	31	0.27 524	9.94 614	6	3
58	9.67 113	23	9.72 506	30	0.27 494	9.94 607	7	2
59	9.67 137	24	9.72 537	31	0.27 463	9.94 600	7	1
60	9.67 161	24	9.72 567	30	0.27 433	9.94 593	7	**0**
′	L. Cos.	d.	L. Cot.	c.d.	L. Tan.	L. Sin.	d.	′

P.P.

″	32	31	30
1	0.5	0.5	0.5
2	1.1	1.0	1.0
3	1.6	1.6	1.5
4	2.1	2.1	2.0
5	2.7	2.6	2.5
6	3.2	3.1	3.0
7	3.7	3.6	3.5
8	4.3	4.1	4.0
9	4.8	4.6	4.5
10	5.3	5.2	5.0
20	10.7	10.3	10.0
30	16.0	15.5	15.0
40	21.3	20.7	20.0
50	26.7	25.8	25.0

″	25	24	23
1	0.4	0.4	0.4
2	0.8	0.8	0.8
3	1.2	1.2	1.2
4	1.7	1.6	1.5
5	2.1	2.0	1.9
6	2.5	2.4	2.3
7	2.9	2.8	2.7
8	3.3	3.2	3.1
9	3.8	3.6	3.4
10	4.2	4.0	3.8
20	8.3	8.0	7.7
30	12.5	12.0	11.5
40	16.7	16.0	15.3
50	20.8	20.0	19.2

″	7	6
1	0.1	0.1
2	0.2	0.2
3	0.4	0.3
4	0.5	0.4
5	0.6	0.5
6	0.7	0.6
7	0.8	0.7
8	0.9	0.8
9	1.0	0.9
10	1.2	1.0
20	2.3	2.0
30	3.5	3.0
40	4.7	4.0
50	5.8	5.0

	7/30	6/31	6/30
0	2.1	2.6	2.5
1	6.4	7.8	7.5
2	10.7	12.9	12.5
3	15.0	18.1	17.5
4	19.3	23.2	22.5
5	23.6	28.4	27.5
6	27.9	—	—
7			

P.P.

117° (247°) (242°) **62°**

28° (208°) (331°) **151°**

′	L. Sin.	d.	L. Tan.	c.d.	L. Cot.	L. Cos.	d.	′
0	9.67 161		9.72 567		0.27 433	9.94 593		**60**
1	9.67 185	24	9.72 598	31	0.27 402	9.94 587	6	59
2	9.67 208	23	9.72 628	30	0.27 372	9.94 580	7	58
3	9.67 232	24	9.72 659	31	0.27 341	9.94 573	7	57
4	9.67 256	24	9.72 689	30	0.27 311	9.94 567	6	56
5	9.67 280	24	9.72 720	31	0.27 280	9.94 560	7	55
6	9.67 303	23	9.72 750	30	0.27 250	9.94 553	7	54
7	9.67 327	24	9.72 780	30	0.27 220	9.94 546	7	53
8	9.67 350	23	9.72 811	31	0.27 189	9.94 540	6	52
9	9.67 374	24	9.72 841	30	0.27 159	9.94 533	7	51
10	9.67 398	24	9.72 872	31	0.27 128	9.94 526	7	**50**
11	9.67 421	23	9.72 902	30	0.27 098	9.94 519	7	49
12	9.67 445	24	9.72 932	30	0.27 068	9.94 513	6	48
13	9.67 468	23	9.72 963	31	0.27 037	9.94 506	7	47
14	9.67 492	24	9.72 993	30	0.27 007	9.94 499	7	46
15	9.67 515	23	9.73 023	30	0.26 977	9.94 492	7	45
16	9.67 539	24	9.73 054	31	0.26 946	9.94 485	7	44
17	9.67 562	23	9.73 084	30	0.26 916	9.94 479	6	43
18	9.67 586	24	9.73 114	30	0.26 886	9.94 472	7	42
19	9.67 609	23	9.73 144	30	0.26 856	9.94 465	7	41
20	9.67 633	24	9.73 175	31	0.26 825	9.94 458	7	**40**
21	9.67 656	23	9.73 205	30	0.26 795	9.94 451	7	39
22	9.67 680	24	9.73 235	30	0.26 765	9.94 445	6	38
23	9.67 703	23	9.73 265	30	0.26 735	9.94 438	7	37
24	9.67 726	23	9.73 295	30	0.26 705	9.94 431	7	36
25	9.67 750	24	9.73 326	31	0.26 674	9.94 424	7	35
26	9.67 773	23	9.73 356	30	0.26 644	9.94 417	7	34
27	9.67 796	23	9.73 386	30	0.26 614	9.94 410	7	33
28	9.67 820	24	9.73 416	30	0.26 584	9.94 404	6	32
29	9.67 843	23	9.73 446	30	0.26 554	9.94 397	7	31
30	9.67 866	23	9.73 476	30	0.26 524	9.94 390	7	**30**
31	9.67 890	24	9.73 507	31	0.26 493	9.94 383	7	29
32	9.67 913	23	9.73 537	30	0.26 463	9.94 376	7	28
33	9.67 936	23	9.73 567	30	0.26 433	9.94 369	7	27
34	9.67 959	23	9.73 597	30	0.26 403	9.94 362	7	26
35	9.67 982	23	9.73 627	30	0.26 373	9.94 355	7	25
36	9.68 006	24	9.73 657	30	0.26 343	9.94 349	6	24
37	9.68 029	23	9.73 687	30	0.26 313	9.94 342	7	23
38	9.68 052	23	9.73 717	30	0.26 283	9.94 335	7	22
39	9.68 075	23	9.73 747	30	0.26 253	9.94 328	7	21
40	9.68 098	23	9.73 777	30	0.26 223	9.94 321	7	**20**
41	9.68 121	23	9.73 807	30	0.26 193	9.94 314	7	19
42	9.68 144	23	9.73 837	30	0.26 163	9.94 307	7	18
43	9.68 167	23	9.73 867	30	0.26 133	9.94 300	7	17
44	9.68 190	23	9.73 897	30	0.26 103	9.94 293	7	16
45	9.68 213	24	9.73 927	30	0.26 073	9.94 286	7	15
46	9.68 237	23	9.73 957	30	0.26 043	9.94 279	7	14
47	9.68 260	23	9.73 987	30	0.26 013	9.94 273	6	13
48	9.68 283	23	9.74 017	30	0.25 983	9.94 266	7	12
49	9.68 305	23	9.74 047	30	0.25 953	9.94 259	7	11
50	9.68 328	23	9.74 077	30	0.25 923	9.94 252	7	**10**
51	9.68 351	23	9.74 107	30	0.25 893	9.94 245	7	9
52	9.68 374	23	9.74 137	29	0.25 863	9.94 238	7	8
53	9.68 397	23	9.74 166	30	0.25 834	9.94 231	7	7
54	9.68 420	23	9.74 196	30	0.25 804	9.94 224	7	6
55	9.68 443	23	9.74 226	30	0.25 774	9.94 217	7	5
56	9.68 466	23	9.74 256	30	0.25 744	9.94 210	7	4
57	9.68 489	23	9.74 286	30	0.25 714	9.94 203	7	3
58	9.68 512	23	9.74 316	30	0.25 684	9.94 196	7	2
59	9.68 534	22	9.74 345	29	0.25 655	9.94 189	7	1
60	9.68 557	23	9.74 375	30	0.25 625	9.94 182	7	**0**
′	L. Cos.	d.	L. Cot.	c.d.	L. Tan.	L. Sin.	d	′

P. P.

	31	30	29
1	0.5	0.5	0.5
2	1.0	1.0	1.0
3	1.6	1.5	1.4
4	2.1	2.0	1.9
5	2.6	2.5	2.4
6	3.1	3.0	2.9
7	3.6	3.5	3.4
8	4.1	4.0	3.9
9	4.6	4.5	4.4
10	5.2	5.0	4.8
20	10.3	10.0	9.7
30	15.5	15.0	14.5
40	20.7	20.0	19.3
50	25.8	25.0	24.2

	24	23	22
1	0.4	0.4	0.4
2	0.8	0.8	0.7
3	1.2	1.2	1.1
4	1.6	1.5	1.5
5	2.0	1.9	1.8
6	2.4	2.3	2.2
7	2.8	2.7	2.6
8	3.2	3.1	2.9
9	3.6	3.4	3.3
10	4.0	3.8	3.7
20	8.0	7.7	7.3
30	12.0	11.5	11.0
40	16.0	15.3	14.7
50	20.0	19.2	18.3

	7	6
1	0.1	0.1
2	0.2	0.2
3	0.4	0.3
4	0.5	0.4
5	0.6	0.5
6	0.7	0.6
7	0.8	0.7
8	0.9	0.8
9	1.0	0.9
10	1.2	1.0
20	2.3	2.0
30	3.5	3.0
40	4.7	4.0
50	5.8	5.0

	7/31	6/31	6/30
0			
1	2.2	2.6	2.5
2	6.6	7.8	7.5
3	11.1	12.9	12.5
4	15.5	18.1	17.5
5	19.9	23.2	22.5
6	24.4	28.4	27.5
7	28.8	—	—

P. P.

118° (298°) (241°) **61°**

29° (209°) (330°) **150°**

′	L. Sin.	d.	L. Tan.	c.d.	L. Cot.	L. Cos.	d.	′
0	9.68 557		9.74 375		0.25 625	9.94 182		**60**
1	9.68 580	23	9.74 405	30	0.25 595	9.94 175	7	59
2	9.68 603	23	9.74 435	30	0.25 565	9.94 168	7	58
3	9.68 625	22	9.74 465	30	0.25 535	9.94 161	7	57
4	9.68 648	23	9.74 494	29	0.25 506	9.94 154	7	56
5	9.68 671	23	9.74 524	30	0.25 476	9.94 147	7	55
6	9.68 694	23	9.74 554	30	0.25 446	9.94 140	7	54
7	9.68 716	22	9.74 583	29	0.25 417	9.94 133	7	53
8	9.68 739	23	9.74 613	30	0.25 387	9.94 126	7	52
9	9.68 762	23	9.74 643	30	0.25 357	9.94 119	7	51
10	9.68 784	22	9.74 673	30	0.25 327	9.94 112	7	**50**
11	9.68 807	23	9.74 702	29	0.25 298	9.94 105	7	49
12	9.68 829	22	9.74 732	30	0.25 268	9.94 098	8	48
13	9.68 852	23	9.74 762	30	0.25 238	9.94 090	7	47
14	9.68 875	23	9.74 791	29	0.25 209	9.94 083	7	46
15	9.68 897	22	9.74 821	30	0.25 179	9.94 076	7	45
16	9.68 920	23	9.74 851	30	0.25 149	9.94 069	7	44
17	9.68 942	22	9.74 880	29	0.25 120	9.94 062	7	43
18	9.68 965	23	9.74 910	30	0.25 090	9.94 055	7	42
19	9.68 987	22	9.74 939	29	0.25 061	9.94 048	7	41
20	9.69 010	23	9.74 969	30	0.25 031	9.94 041	7	**40**
21	9.69 032	22	9.74 998	29	0.25 002	9.94 034	7	39
22	9.69 055	23	9.75 028	30	0.24 972	9.94 027	7	38
23	9.69 077	22	9.75 058	30	0.24 942	9.94 020	8	37
24	9.69 100	23	9.75 087	29	0.24 913	9.94 012	7	36
25	9.69 122	22	9.75 117	30	0.24 883	9.94 005	7	35
26	9.69 144	22	9.75 146	29	0.24 854	9.93 998	7	34
27	9.69 167	23	9.75 176	30	0.24 824	9.93 991	7	33
28	9.69 189	22	9.75 205	29	0.24 795	9.93 984	7	32
29	9.69 212	23	9.75 235	30	0.24 765	9.93 977	7	31
30	9.69 234	22	9.75 264	29	0.24 736	9.93 970	7	**30**
31	9.69 256	22	9.75 294	30	0.24 706	9.93 963	8	29
32	9.69 279	23	9.75 323	29	0.24 677	9.93 955	7	28
33	9.69 301	22	9.75 353	30	0.24 647	9.93 948	7	27
34	9.69 323	22	9.75 382	29	0.24 618	9.93 941	7	26
35	9.69 345	22	9.75 411	29	0.24 589	9.93 934	7	25
36	9.69 368	23	9.75 441	30	0.24 559	9.93 927	7	24
37	9.69 390	22	9.75 470	30	0.24 530	9.93 920	8	23
38	9.69 412	22	9.75 500	30	0.24 500	9.93 912	7	22
39	9.69 434	22	9.75 529	29	0.24 471	9.93 905	7	21
40	9.69 456	22	9.75 558	29	0.24 442	9.93 898	7	**20**
41	9.69 479	23	9.75 588	30	0.24 412	9.93 891	7	19
42	9.69 501	22	9.75 617	29	0.24 383	9.93 884	8	18
43	9.69 523	22	9.75 647	30	0.24 353	9.93 876	7	17
44	9.69 545	22	9.75 676	29	0.24 324	9.93 869	7	16
45	9.69 567	22	9.75 705	29	0.24 295	9.93 862	7	15
46	9.69 589	22	9.75 735	30	0.24 265	9.93 855	7	14
47	9.69 611	22	9.75 764	29	0.24 236	9.93 847	8	13
48	9.69 633	22	9.75 793	29	0.24 207	9.93 840	7	12
49	9.69 655	22	9.75 822	29	0.24 178	9.93 833	7	11
50	9.69 677	22	9.75 852	30	0.24 148	9.93 826	7	**10**
51	9.69 699	22	9.75 881	29	0.24 119	9.93 819	7	9
52	9.69 721	22	9.75 910	29	0.24 090	9.93 811	8	8
53	9.69 743	22	9.75 939	29	0.24 061	9.93 804	7	7
54	9.69 765	22	9.75 969	30	0.24 031	9.93 797	7	6
55	9.69 787	22	9.75 998	29	0.24 002	9.93 789	8	5
56	9.69 809	22	9.76 027	29	0.23 973	9.93 782	7	4
57	9.69 831	22	9.76 056	29	0.23 944	9.93 775	7	3
58	9.69 853	22	9.76 086	30	0.23 914	9.93 768	7	2
59	9.69 875	22	9.76 115	29	0.23 885	9.93 760	8	1
60	9.69 897		9.76 144	29	0.23 856	9.93 753	7	**0**
′	L. Cos.	d.	L. Cot.	c.d.	L. Tan.	L. Sin.	d.	′

P. P.

	30	29	23
1	0.5	0.5	0.4
2	1.0	1.0	0.8
3	1.5	1.4	1.2
4	2.0	1.9	1.5
5	2.5	2.4	1.9
6	3.0	2.9	2.3
7	3.5	3.4	2.7
8	4.0	3.9	3.1
9	4.5	4.4	3.4
10	5.0	4.8	3.8
20	10.0	9.7	7.7
30	15.0	14.5	11.5
40	20.0	19.3	15.3
50	25.0	24.2	19.2

	22	8	7
1	0.4	0.1	0.1
2	0.7	0.3	0.2
3	1.1	0.4	0.4
4	1.5	0.5	0.5
5	1.8	0.7	0.6
6	2.2	0.8	0.7
7	2.6	0.9	0.8
8	2.9	1.1	0.9
9	3.3	1.2	1.0
10	3.7	1.3	1.2
20	7.3	2.7	2.3
30	11.0	4.0	3.5
40	14.7	5.3	4.7
50	18.3	6.7	5.8

	8/30	8/29
0	1.9	1.8
1	5.6	5.4
2	9.4	9.1
3	13.1	12.7
4	16.9	16.3
5	20.6	19.9
6	24.4	23.6
7	28.1	27.2
8		

	7/30	7/29
0	2.1	2.1
1	6.4	6.2
2	10.7	10.4
3	15.0	14.5
4	19.3	18.6
5	23.6	22.8
6	27.9	26.9
7		

P. P.

119° (299°) (240°) **60°**

30° (210°) (329°) **149°**

′	L. Sin.	d.	L. Tan.	c.d.	L. Cot.	L. Cos.	d.	′
0	9.69 897		9.76 144		0.23 856	9.93 753	7	**60**
1	9.69 919	22	9.76 173	29	0.23 827	9.93 746	8	59
2	9.69 941	22	9.76 202	29	0.23 798	9.93 738	7	58
3	9.69 963	22	9.76 231	29	0.23 769	9.93 731	7	57
4	9.69 984	21	9.76 261	30	0.23 739	9.93 724	7	56
		22		29			8	
5	9.70 006		9.76 290		0.23 710	9.93 717	7	55
6	9.70 028	22	9.76 319	29	0.23 681	9.93 709	8	54
7	9.70 050	22	9.76 348	29	0.23 652	9.93 702	7	53
8	9.70 072	22	9.76 377	29	0.23 623	9.93 695	8	52
9	9.70 093	21	9.76 406	29	0.23 594	9.93 687	7	51
		22		29			8	
10	9.70 115		9.76 435		0.23 565	9.93 680	7	**50**
11	9.70 137	22	9.76 464	29	0.23 536	9.93 673	8	49
12	9.70 159	22	9.76 493	29	0.23 507	9.93 665	8	48
13	9.70 180	21	9.76 522	29	0.23 478	9.93 658	8	47
14	9.70 202	22	9.76 551	29	0.23 449	9.93 650	7	46
		22		29			8	
15	9.70 224		9.76 580		0.23 420	9.93 643	7	45
16	9.70 245	21	9.76 609	29	0.23 391	9.93 636	8	44
17	9.70 267	22	9.76 639	30	0.23 361	9.93 628	8	43
18	9.70 288	21	9.76 668	29	0.23 332	9.93 621	7	42
19	9.70 310	22	9.76 697	29	0.23 303	9.93 614	8	41
		22		28			7	
20	9.70 332		9.76 725		0.23 275	9.93 606	8	**40**
21	9.70 353	21	9.76 754	29	0.23 246	9.93 599	8	39
22	9.70 375	22	9.76 783	29	0.23 217	9.93 591	8	38
23	9.70 396	21	9.76 812	29	0.23 188	9.93 584	7	37
24	9.70 418	22	9.76 841	29	0.23 159	9.93 577	8	36
		21		29			7	
25	9.70 439		9.76 870		0.23 130	9.93 569	8	35
26	9.70 461	22	9.76 899	29	0.23 101	9.93 562	7	34
27	9.70 482	21	9.76 928	29	0.23 072	9.93 554	8	33
28	9.70 504	22	9.76 957	29	0.23 043	9.93 547	7	32
29	9.70 525	21	9.76 986	29	0.23 014	9.93 539	8	31
		22		29			7	
30	9.70 547		9.77 015		0.22 985	9.93 532	7	**30**
31	9.70 568	21	9.77 044	29	0.22 956	9.93 527	8	29
32	9.70 590	22	9.77 073	29	0.22 927	9.93 515	7	28
33	9.70 611	21	9.77 101	28	0.22 899	9.93 510	8	27
34	9.70 633	22	9.77 130	29	0.22 870	9.93 502	7	26
		21		29			8	
35	9.70 654		9.77 159		0.22 841	9.93 495	7	25
36	9.70 675	21	9.77 188	29	0.22 812	9.93 487	8	24
37	9.70 697	22	9.77 217	29	0.22 783	9.93 480	7	23
38	9.70 718	21	9.77 246	29	0.22 754	9.93 472	8	22
39	9.70 739	21	9.77 274	28	0.22 726	9.93 465	7	21
		22		29			8	
40	9.70 761		9.77 303		0.22 697	9.93 457	7	**20**
41	9.70 782	21	9.77 332	29	0.22 668	9.93 450	8	19
42	9.70 803	21	9.77 361	29	0.22 639	9.93 442	7	18
43	9.70 824	21	9.77 390	29	0.22 610	9.93 435	8	17
44	9.70 846	22	9.77 418	28	0.22 582	9.93 427	7	16
		21		29			8	
45	9.70 867		9.77 447		0.22 553	9.93 420	7	15
46	9.70 888	21	9.77 476	29	0.22 524	9.93 412	8	14
47	9.70 909	21	9.77 505	29	0.22 495	9.93 405	7	13
48	9.70 931	22	9.77 533	28	0.22 467	9.93 397	8	12
49	9.70 952	21	9.77 562	29	0.22 438	9.93 390	7	11
		21		29			8	
50	9.70 973		9.77 591		0.22 409	9.93 382	7	**10**
51	9.70 994	21	9.77 619	28	0.22 381	9.93 375	8	9
52	9.71 015	21	9.77 648	29	0.22 352	9.93 367	7	8
53	9.71 036	21	9.77 677	29	0.22 323	9.93 360	8	7
54	9.71 058	22	9.77 706	29	0.22 294	9.93 352	8	6
		21		28			7	
55	9.71 079		9.77 734		0.22 266	9.93 344	8	5
56	9.71 100	21	9.77 763	29	0.22 237	9.93 337	7	4
57	9.71 121	21	9.77 791	28	0.22 209	9.93 329	8	3
58	9.71 142	21	9.77 820	29	0.22 180	9.93 322	7	2
59	9.71 163	21	9.77 849	29	0.22 151	9.93 314	8	1
		21		28			7	
60	9.71 184		9.77 877		0.22 123	9.93 307		**0**
′	L. Cos.	d.	L. Cot.	c.d.	L. Tan.	L. Sin.	d.	′

P.P.

	30	29	28
1	0.5	0.5	0.5
2	1.0	1.0	0.9
3	1.5	1.4	1.4
4	2.0	1.9	1.9
5	2.5	2.4	2.3
6	3.0	2.9	2.8
7	3.5	3.4	3.3
8	4.0	3.9	3.7
9	4.5	4.4	4.2
10	5.0	4.8	4.7
20	10.0	9.7	9.3
30	15.0	14.5	14.0
40	20.0	19.3	18.7
50	25.0	24.2	23.3

	22	21
1	0.4	0.4
2	0.7	0.7
3	1.1	1.0
4	1.5	1.4
5	1.8	1.8
6	2.2	2.1
7	2.6	2.4
8	2.9	2.8
9	3.3	3.2
10	3.7	3.5
20	7.3	7.0
30	11.0	10.5
40	14.7	14.0
50	18.3	17.5

	8	7
1	0.1	0.1
2	0.3	0.2
3	0.4	0.4
4	0.5	0.5
5	0.7	0.6
6	0.8	0.7
7	0.9	0.8
8	1.1	0.9
9	1.2	1.0
10	1.3	1.2
20	2.7	2.3
30	4.0	3.5
40	5.3	4.7
50	6.7	5.8

	7/30	7/29	7/28
0			
1	2.1	2.1	2.0
2	6.4	6.2	6.0
3	10.7	10.4	10.0
4	15.0	14.5	14.0
5	19.3	18.6	18.0
6	23.6	22.8	22.0
7	27.9	26.9	26.0

P.P.

120° (300°) (239°) **59°**

31° (211°) (328°) 148°

′	L. Sin.	d.	L. Tan.	c.d.	L. Cot.	L. Cos.	d.	′
0	9.71 184		9.77 877		0.22 123	9.93 307		60
1	9.71 205	21	9.77 906	29	0.22 094	9.93 299	8	59
2	9.71 226	21	9.77 935	29	0.22 065	9.93 291	8	58
3	9.71 247	21	9.77 963	28	0.22 037	9.93 284	7	57
4	9.71 268	21	9.77 992	29	0.22 008	9.93 276	8	56
5	9.71 289	21	9.78 020	28	0.21 980	9.93 269	7	55
6	9.71 310	21	9.78 049	29	0.21 951	9.93 261	8	54
7	9.71 331	21	9.78 077	28	0.21 923	9.93 253	8	53
8	9.71 352	21	9.78 106	29	0.21 894	9.93 246	8	52
9	9.71 373	21	9.78 135	29	0.21 865	9.93 238	8	51
10	9.71 393	20	9.78 163	28	0.21 837	9.93 230	8	50
11	9.71 414	21	9.78 192	29	0.21 808	9.93 223	7	49
12	9.71 435	21	9.78 220	28	0.21 780	9.93 215	8	48
13	9.71 456	21	9.78 249	29	0.21 751	9.93 207	8	47
14	9.71 477	21	9.78 277	28	0.21 723	9.93 200	7	46
15	9.71 498	21	9.78 306	29	0.21 694	9.93 192	8	45
16	9.71 519	21	9.78 334	28	0.21 666	9.93 184	8	44
17	9.71 539	20	9.78 363	29	0.21 637	9.93 177	7	43
18	9.71 560	21	9.78 391	28	0.21 609	9.93 169	8	42
19	9.71 581	21	9.78 419	28	0.21 581	9.93 161	8	41
20	9.71 602	21	9.78 448	29	0.21 552	9.93 154	7	40
21	9.71 622	20	9.78 476	28	0.21 524	9.93 146	8	39
22	9.71 643	21	9.78 505	29	0.21 495	9.93 138	8	38
23	9.71 664	21	9.78 533	28	0.21 467	9.93 131	7	37
24	9.71 685	21	9.78 562	29	0.21 438	9.93 123	8	36
25	9.71 705	20	9.78 590	28	0.21 410	9.93 115	8	35
26	9.71 726	21	9.78 618	28	0.21 382	9.93 108	7	34
27	9.71 747	21	9.78 647	29	0.21 353	9.93 100	8	33
28	9.71 767	20	9.78 675	28	0.21 325	9.93 092	8	32
29	9.71 788	21	9.78 704	29	0.21 296	9.93 084	8	31
30	9.71 809	21	9.78 732	28	0.21 268	9.93 077	7	30
31	9.71 829	20	9.78 760	28	0.21 240	9.93 069	8	29
32	9.71 850	21	9.78 789	29	0.21 211	9.93 061	8	28
33	9.71 870	20	9.78 817	28	0.21 183	9.93 053	8	27
34	9.71 891	21	9.78 845	28	0.21 155	9.93 046	7	26
35	9.71 911	20	9.78 874	29	0.21 126	9.93 038	8	25
36	9.71 932	21	9.78 902	28	0.21 098	9.93 030	8	24
37	9.71 952	20	9.78 930	28	0.21 070	9.93 022	8	23
38	9.71 973	21	9.78 959	29	0.21 041	9.93 014	8	22
39	9.71 994	21	9.78 987	28	0.21 013	9.93 007	7	21
40	9.72 014	20	9.79 015	28	0.20 985	9.92 999	8	20
41	9.72 034	20	9.79 043	28	0.20 957	9.92 991	8	19
42	9.72 055	21	9.79 072	29	0.20 928	9.92 983	8	18
43	9.72 075	20	9.79 100	28	0.20 900	9.92 976	7	17
44	9.72 096	21	9.79 128	28	0.20 872	9.92 968	8	16
45	9.72 116	20	9.79 156	28	0.20 844	9.92 960	8	15
46	9.72 137	21	9.79 185	29	0.20 815	9.92 952	8	14
47	9.72 157	20	9.79 213	28	0.20 787	9.92 944	8	13
48	9.72 177	20	9.79 241	28	0.20 759	9.92 936	8	12
49	9.72 198	21	9.79 269	28	0.20 731	9.92 929	7	11
50	9.72 218	20	9.79 297	28	0.20 703	9.92 921	8	10
51	9.72 238	20	9.79 326	29	0.20 674	9.92 913	8	9
52	9.72 259	21	9.79 354	28	0.20 646	9.92 905	8	8
53	9.72 279	20	9.79 382	28	0.20 618	9.92 897	8	7
54	9.72 299	20	9.79 410	28	0.20 590	9.92 889	8	6
55	9.72 320	21	9.79 438	28	0.20 562	9.92 881	8	5
56	9.72 340	20	9.79 466	28	0.20 534	9.92 874	7	4
57	9.72 360	20	9.79 495	29	0.20 505	9.92 866	8	3
58	9.72 381	21	9.79 523	28	0.20 477	9.92 858	8	2
59	9.72 401	20	9.79 551	28	0.20 449	9.92 850	8	1
60	9.72 421		9.79 579		0.20 421	9.92 842	8	0
′	L. Cos.	d.	L. Cot.	c.d.	L. Tan.	L. Sin.	d.	′

P.P.

″	29	28
1	0.5	0.5
2	1.0	0.9
3	1.4	1.4
4	1.9	1.9
5	2.4	2.3
6	2.9	2.8
7	3.4	3.3
8	3.9	3.7
9	4.4	4.2
10	4.8	4.7
20	9.7	9.3
30	14.5	14.0
40	19.3	18.7
50	24.2	23.3

″	21	20
1	0.4	0.3
2	0.7	0.7
3	1.0	1.0
4	1.4	1.3
5	1.8	1.7
6	2.1	2.0
7	2.4	2.3
8	2.8	2.7
9	3.2	3.0
10	3.5	3.3
20	7.0	6.7
30	10.5	10.0
40	14.0	13.3
50	17.5	16.7

″	8	7
1	0.1	0.1
2	0.3	0.2
3	0.4	0.4
4	0.5	0.5
5	0.7	0.6
6	0.8	0.7
7	0.9	0.8
8	1.1	0.9
9	1.2	1.0
10	1.3	1.2
20	2.7	2.3
30	4.0	3.5
40	5.3	4.7
50	6.7	5.8

	8/30	8/29	8/28
0	1.9	1.8	1.8
1	5.6	5.4	5.2
2	9.4	9.1	8.8
3	13.1	12.7	12.2
4	16.9	16.3	15.8
5	20.6	19.9	19.2
6	24.4	23.6	22.8
7	28.1	27.2	26.2
8			

P.P.

121° (301°) (238°) 58°

32° (212°) **(327°) 147°**

′	L. Sin.	d.	L. Tan.	c.d.	L. Cot.	L. Cos.	d.	′
0	9.72 421		9.79 579		0.20 421	9.92 842		**60**
1	9.72 441	20	9.79 607	28	0.20 393	9.92 834	8	59
2	9.72 461	20	9.79 635	28	0.20 365	9.92 826	8	58
3	9.72 482	21	9.79 663	28	0.20 337	9.92 818	8	57
4	9.72 502	20	9.79 691	28	0.20 309	9.92 810	8	56
5	9.72 522	20	9.79 719	28	0.20 281	9.92 803	7	55
6	9.72 542	20	9.79 747	29	0.20 253	9.92 795	8	54
7	9.72 562	20	9.79 776	28	0.20 224	9.92 787	8	53
8	9.72 582	20	9.79 804	28	0.20 196	9.92 779	8	52
9	9.72 602	20	9.79 832	28	0.20 168	9.92 771	8	51
10	9.72 622		9.79 860		0.20 140	9.92 763	8	**50**
11	9.72 643	21	9.79 888	28	0.20 112	9.92 755	8	49
12	9.72 663	20	9.79 916	28	0.20 084	9.92 747	8	48
13	9.72 683	20	9.79 944	28	0.20 056	9.92 739	8	47
14	9.72 703	20	9.79 972	28	0.20 028	9.92 731	8	46
15	9.72 723	20	9.80 000	28	0.20 000	9.92 723	8	45
16	9.72 743	20	9.80 028	28	0.19 972	9.92 715	8	44
17	9.72 763	20	9.80 056	28	0.19 944	9.92 707	8	43
18	9.72 783	20	9.80 084	28	0.19 916	9.92 699	8	42
19	9.72 803	20	9.80 112	28	0.19 888	9.92 691	8	41
20	9.72 823	20	9.80 140	28	0.19 860	9.92 683	8	**40**
21	9.72 843	20	9.80 168	28	0.19 832	9.92 675	8	39
22	9.72 863	20	9.80 195	27	0.19 805	9.92 667	8	38
23	9.72 883	20	9.80 223	28	0.19 777	9.92 659	8	37
24	9.72 902	19	9.80 251	28	0.19 749	9.92 651	8	36
25	9.72 922	20	9.80 279	28	0.19 721	9.92 643	8	35
26	9.72 942	20	9.80 307	28	0.19 693	9.92 635	8	34
27	9.72 962	20	9.80 335	28	0.19 665	9.92 627	8	33
28	9.72 982	20	9.80 363	28	0.19 637	9.92 619	8	32
29	9.73 002	20	9.80 391	28	0.19 609	9.92 611	8	31
30	9.73 022	19	9.80 419	28	0.19 581	9.92 603	8	**30**
31	9.73 041	20	9.80 447	27	0.19 553	9.92 595	8	29
32	9.73 061	20	9.80 474	28	0.19 526	9.92 587	8	28
33	9.73 081	20	9.80 502	28	0.19 498	9.92 579	8	27
34	9.73 101	20	9.80 530	28	0.19 470	9.92 571	8	26
35	9.73 121	19	9.80 558	28	0.19 442	9.92 563	8	25
36	9.73 140	20	9.80 586	28	0.19 414	9.92 555	8	24
37	9.73 160	20	9.80 614	28	0.19 386	9.92 546	9	23
38	9.73 180	20	9.80 642	27	0.19 358	9.92 538	8	22
39	9.73 200	20	9.80 669	28	0.19 331	9.92 530	8	21
40	9.73 219	19	9.80 697	28	0.19 303	9.92 522	8	**20**
41	9.73 239	20	9.80 725	28	0.19 275	9.92 514	8	19
42	9.73 259	20	9.80 753	28	0.19 247	9.92 506	8	18
43	9.73 278	19	9.80 781	28	0.19 219	9.92 498	8	17
44	9.73 298	20	9.80 808	27	0.19 192	9.92 490	8	16
45	9.73 318	20	9.80 836	28	0.19 164	9.92 482	8	15
46	9.73 337	19	9.80 864	28	0.19 136	9.92 473	9	14
47	9.73 357	20	9.80 892	28	0.19 108	9.92 465	8	13
48	9.73 377	20	9.80 919	27	0.19 081	9.92 457	8	12
49	9.73 396	19	9.80 947	28	0.19 053	9.92 449	8	11
50	9.73 416	20	9.80 975	28	0.19 025	9.92 441	8	**10**
51	9.73 435	19	9.81 003	28	0.18 997	9.92 433	8	9
52	9.73 455	20	9.81 030	27	0.18 970	9.92 425	8	8
53	9.73 474	19	9.81 058	28	0.18 942	9.92 416	8	7
54	9.73 494	20	9.81 086	28	0.18 914	9.92 408	8	6
55	9.73 513	19	9.81 113	27	0.18 887	9.92 400	8	5
56	9.73 533	20	9.81 141	28	0.18 859	9.92 392	8	4
57	9.73 552	19	9.81 169	28	0.18 831	9.92 384	8	3
58	9.73 572	20	9.81 196	27	0.18 804	9.92 376	9	2
59	9.73 591	19	9.81 224	28	0.18 776	9.92 367	8	1
60	9.73 611	20	9.81 252	28	0.18 748	9.92 359	8	**0**
′	L. Cos.	d.	L. Cot.	c.d.	L. Tan.	L. Sin.	d.	′

P. P.			
	29	**28**	**27**
1	0.5	0.5	0.4
2	1.0	0.9	0.9
3	1.4	1.4	1.4
4	1.9	1.9	1.8
5	2.4	2.3	2.3
6	2.9	2.8	2.7
7	3.4	3.3	3.2
8	3.9	3.7	3.6
9	4.4	4.2	4.0
10	4.8	4.7	4.5
20	9.7	9.3	9.0
30	14.5	14.0	13.5
40	19.3	18.7	18.0
50	24.2	23.3	22.5

P. P.			
	21	**20**	**19**
1	0.4	0.3	0.3
2	0.7	0.7	0.6
3	1.0	1.0	1.0
4	1.4	1.3	1.3
5	1.8	1.7	1.6
6	2.1	2.0	1.9
7	2.4	2.3	2.2
8	2.8	2.7	2.5
9	3.2	3.0	2.8
10	3.5	3.3	3.2
20	7.0	6.7	6.3
30	10.5	10.0	9.5
40	14.0	13.3	12.7
50	17.5	16.7	15.8

P. P.			
	9	**8**	**7**
1	0.2	0.1	0.1
2	0.3	0.3	0.2
3	0.4	0.4	0.4
4	0.6	0.5	0.5
5	0.8	0.7	0.6
6	0.9	0.8	0.8
7	1.0	0.9	0.9
8	1.2	1.1	1.0
9	1.4	1.2	1.1
10	1.5	1.3	1.3
20	3.0	2.7	2.5
30	4.5	4.0	3.8
40	6.0	5.3	4.9
50	7.5	6.7	6.3

P. P.			
	8	**8**	**7**
	29	**28**	**28**
0	1.8	1.8	2.0
1	5.4	5.2	6.0
2	9.1	8.8	10.0
3	12.7	12.2	14.0
4	16.3	15.8	18.0
5	19.9	19.2	22.0
6	23.6	22.8	26.0
7	27.2	26.2	30.0
8			

122° (202°) **(237°) 57°**

33° (213°) (326°) **146°**

′	L. Sin.	d.	L. Tan.	c.d.	L. Cot.	L. Cos.	d.	′
0	9.73 611		9.81 252		0.18 748	9.92 359		**60**
1	9.73 630	19	9.81 279	27	0.18 721	9.92 351	8	59
2	9.73 650	20	9.81 307	28	0.18 693	9.92 343	8	58
3	9.73 669	19	9.81 335	28	0.18 665	9.92 335	8	57
4	9.73 689	20	9.81 362	27	0.18 638	9.92 326	9	56
5	9.73 708	19	9.81 390	28	0.18 610	9.92 318	8	55
6	9.73 727	19	9.81 418	28	0.18 582	9.92 310	8	54
7	9.73 747	20	9.81 445	27	0.18 555	9.92 302	8	53
8	9.73 766	19	9.81 473	28	0.18 527	9.92 293	9	52
9	9.73 785	19	9.81 500	27	0.18 500	9.92 285	8	51
10	9.73 805	20	9.81 528	28	0.18 472	9.92 277	8	**50**
11	9.73 824	19	9.81 556	28	0.18 444	9.92 269	8	49
12	9.73 843	19	9.81 583	27	0.18 417	9.92 260	9	48
13	9.73 863	20	9.81 611	28	0.18 389	9.92 252	8	47
14	9.73 882	19	9.81 638	27	0.18 362	9.92 244	8	46
15	9.73 901	19	9.81 666	28	0.18 334	9.92 235	9	45
16	9.73 921	20	9.81 693	27	0.18 307	9.92 227	8	44
17	9.73 940	19	9.81 721	28	0.18 279	9.92 219	8	43
18	9.73 959	19	9.81 748	27	0.18 252	9.92 211	8	42
19	9.73 978	19	9.81 776	28	0.18 224	9.92 202	9	41
20	9.73 997	19	9.81 803	27	0.18 197	9.92 194	8	**40**
21	9.74 017	20	9.81 831	28	0.18 169	9.92 186	8	39
22	9.74 036	19	9.81 858	27	0.18 142	9.92 177	8	38
23	9.74 055	19	9.81 886	28	0.18 114	9.92 169	8	37
24	9.74 074	19	9.81 913	27	0.18 087	9.92 161	9	36
25	9.74 093	19	9.81 941	28	0.18 059	9.92 152	8	35
26	9.74 113	20	9.81 968	27	0.18 032	9.92 144	8	34
27	9.74 132	19	9.81 996	28	0.18 004	9.92 136	8	33
28	9.74 151	19	9.82 023	27	0.17 977	9.92 127	9	32
29	9.74 170	19	9.82 051	28	0.17 949	9.92 119	8	31
30	9.74 189	19	9.82 078	27	0.17 922	9.92 111	8	**30**
31	9.74 208	19	9.82 106	28	0.17 894	9.92 102	9	29
32	9.74 227	19	9.82 133	27	0.17 867	9.92 094	8	28
33	9.74 246	19	9.82 161	28	0.17 839	9.92 086	8	27
34	9.74 265	19	9.82 188	27	0.17 812	9.92 077	9	26
35	9.74 284	19	9.82 215	27	0.17 785	9.92 069	8	25
36	9.74 303	19	9.82 243	28	0.17 757	9.92 060	9	24
37	9.74 322	19	9.82 270	27	0.17 730	9.92 052	8	23
38	9.74 341	19	9.82 298	28	0.17 702	9.92 044	9	22
39	9.74 360	19	9.82 325	27	0.17 675	9.92 035	8	21
40	9.74 379	19	9.82 352	27	0.17 648	9.92 027	9	**20**
41	9.74 398	19	9.82 380	28	0.17 620	9.92 018	9	19
42	9.74 417	19	9.82 407	27	0.17 593	9.92 010	8	18
43	9.74 436	19	9.82 435	28	0.17 565	9.92 002	9	17
44	9.74 455	19	9.82 462	27	0.17 538	9.91 993	9	16
45	9.74 474	19	9.82 489	27	0.17 511	9.91 985	8	15
46	9.74 493	19	9.82 517	28	0.17 483	9.91 976	9	14
47	9.74 512	19	9.82 544	27	0.17 456	9.91 968	8	13
48	9.74 531	19	9.82 571	27	0.17 429	9.91 959	9	12
49	9.74 549	18	9.82 599	28	0.17 401	9.91 951	8	11
50	9.74 568	19	9.82 626	27	0.17 374	9.91 942	9	**10**
51	9.74 587	19	9.82 653	27	0.17 347	9.91 934	8	9
52	9.74 606	19	9.82 681	28	0.17 319	9.91 925	9	8
53	9.74 625	19	9.82 708	27	0.17 292	9.91 917	8	7
54	9.74 644	19	9.82 735	27	0.17 265	9.91 908	9	6
55	9.74 662	18	9.82 762	27	0.17 238	9.91 900	9	5
56	9.74 681	19	9.82 790	28	0.17 210	9.91 891	9	4
57	9.74 700	19	9.82 817	27	0.17 183	9.91 883	8	3
58	9.74 719	19	9.82 844	27	0.17 156	9.91 874	9	2
59	9.74 737	18	9.82 871	27	0.17 129	9.91 866	9	1
60	9.74 756	19	9.82 899	28	0.17 101	9.91 857	9	**0**
′	L. Cos.	d.	L. Cot.	c.d.	L. Tan.	L. Sin.	d.	′

P. P.

	28	27
1	0.5	0.4
2	0.9	0.9
3	1.4	1.4
4	1.9	1.8
5	2.3	2.2
6	2.8	2.7
7	3.3	3.2
8	3.7	3.6
9	4.2	4.0
10	4.7	4.5
20	9.3	9.0
30	14.0	13.5
40	18.7	18.0
50	23.3	22.5

	20	19	18
1	0.3	0.3	0.3
2	0.7	0.6	0.6
3	1.0	1.0	0.9
4	1.3	1.3	1.2
5	1.7	1.6	1.5
6	2.0	1.9	1.8
7	2.3	2.2	2.1
8	2.7	2.5	2.4
9	3.0	2.8	2.7
10	3.3	3.2	3.0
20	6.7	6.3	6.0
30	10.0	9.5	9.0
40	13.3	12.7	12.0
50	16.7	15.8	15.0

	9	8
1	0.2	0.1
2	0.3	0.3
3	0.4	0.4
4	0.6	0.5
5	0.8	0.7
6	0.9	0.8
7	1.0	0.9
8	1.2	1.1
9	1.4	1.2
10	1.5	1.3
20	3.0	2.7
30	4.5	4.0
40	6.0	5.3
50	7.5	6.7

	$\frac{9}{28}$	$\frac{9}{27}$	$\frac{8}{27}$
0			
1	1.6	1.5	1.7
2	4.7	4.5	5.1
3	7.8	7.5	8.4
4	10.9	10.5	11.8
5	14.0	13.5	15.2
6	17.1	16.5	18.6
7	20.2	19.5	21.9
8	23.3	22.5	25.3
9	26.4	25.5	—

P. P.

123° (303°) (236°) **56°**

34° (214°) (325°) **145°**

′	L. Sin.	d.	L. Tan.	c.d.	L. Cot.	L. Cos.	d.	′
0	9.74 756	19	9.82 899	27	0.17 101	9.91 857	8	**60**
1	9.74 775	19	9.82 926	27	0.17 074	9.91 849	9	59
2	9.74 794	19	9.82 953	27	0.17 047	9.91 840	9	58
3	9.74 812	18	9.82 980	27	0.17 020	9.91 832	9	57
4	9.74 831	19	9.83 008	28	0.16 992	9.91 823	9	56
5	9.74 850	18	9.83 035	27	0.16 965	9.91 815	9	55
6	9.74 868	19	9.83 062	27	0.16 938	9.91 806	9	54
7	9.74 887	19	9.83 089	27	0.16 911	9.91 798	8	53
8	9.74 906	18	9.83 117	28	0.16 883	9.91 789	9	52
9	9.74 924	19	9.83 144	27	0.16 856	9.91 781	8	51
10	9.74 943	18	9.83 171	27	0.16 829	9.91 772	9	**50**
11	9.74 961	19	9.83 198	27	0.16 802	9.91 763	9	49
12	9.74 980	19	9.83 225	27	0.16 775	9.91 755	8	48
13	9.74 999	18	9.83 252	28	0.16 748	9.91 746	9	47
14	9.75 017	19	9.83 280	27	0.16 720	9.91 738	8	46
15	9.75 036	18	9.83 307	27	0.16 693	9.91 729	9	45
16	9.75 054	19	9.83 334	27	0.16 666	9.91 720	9	44
17	9.75 073	18	9.83 361	27	0.16 639	9.91 712	8	43
18	9.75 091	19	9.83 388	27	0.16 612	9.91 703	9	42
19	9.75 110	18	9.83 415	27	0.16 585	9.91 695	8	41
20	9.75 128	19	9.83 442	28	0.16 558	9.91 686	9	**40**
21	9.75 147	18	9.83 470	27	0.16 530	9.91 677	9	39
22	9.75 165	19	9.83 497	27	0.16 503	9.91 669	8	38
23	9.75 184	18	9.83 524	27	0.16 476	9.91 660	9	37
24	9.75 202	19	9.83 551	27	0.16 449	9.91 651	9	36
25	9.75 221	18	9.83 578	27	0.16 422	9.91 643	8	35
26	9.75 239	18	9.83 605	27	0.16 395	9.91 634	9	34
27	9.75 258	18	9.83 632	27	0.16 368	9.91 625	9	33
28	9.75 276	18	9.83 659	27	0.16 341	9.91 617	8	32
29	9.75 294	19	9.83 686	27	0.16 314	9.91 608	9	31
30	9.75 313	18	9.83 713	27	0.16 287	9.91 599	9	**30**
31	9.75 331	19	9.83 740	28	0.16 260	9.91 591	8	29
32	9.75 350	18	9.83 768	27	0.16 232	9.91 582	9	28
33	9.75 368	18	9.83 795	27	0.16 205	9.91 573	9	27
34	9.75 386	19	9.83 822	27	0.16 178	9.91 565	8	26
35	9.75 405	18	9.83 849	27	0.16 151	9.91 556	9	25
36	9.75 423	18	9.83 876	27	0.16 124	9.91 547	9	24
37	9.75 441	18	9.83 903	27	0.16 097	9.91 538	9	23
38	9.75 459	18	9.83 930	27	0.16 070	9.91 530	8	22
39	9.75 478	19	9.83 957	27	0.16 043	9.91 521	9	21
40	9.75 496	18	9.83 984	27	0.16 016	9.91 512	9	**20**
41	9.75 514	18	9.84 011	27	0.15 989	9.91 504	8	19
42	9.75 533	19	9.84 038	27	0.15 962	9.91 495	9	18
43	9.75 551	18	9.84 065	27	0.15 935	9.91 486	9	17
44	9.75 569	18	9.84 092	27	0.15 908	9.91 477	9	16
45	9.75 587	18	9.84 119	27	0.15 881	9.91 469	8	15
46	9.75 605	19	9.84 146	27	0.15 854	9.91 460	9	14
47	9.75 624	18	9.84 173	27	0.15 827	9.91 451	9	13
48	9.75 642	18	9.84 200	27	0.15 800	9.91 442	9	12
49	9.75 660	18	9.84 227	27	0.15 773	9.91 433	9	11
50	9.75 678	18	9.84 254	26	0.15 746	9.91 425	8	**10**
51	9.75 696	18	9.84 280	27	0.15 720	9.91 416	9	9
52	9.75 714	18	9.84 307	27	0.15 693	9.91 407	9	8
53	9.75 733	19	9.84 334	27	0.15 666	9.91 398	9	7
54	9.75 751	18	9.84 361	27	0.15 639	9.91 389	9	6
55	9.75 769	18	9.84 388	27	0.15 612	9.91 381	8	5
56	9.75 787	18	9.84 415	27	0.15 585	9.91 372	9	4
57	9.75 805	18	9.84 442	27	0.15 558	9.91 363	9	3
58	9.75 823	18	9.84 469	27	0.15 531	9.91 354	9	2
59	9.75 841	18	9.84 496	27	0.15 504	9.91 345	9	1
60	9.75 859		9.84 523		0.15 477	9.91 336	9	**0**
′	L. Cos.	d.	L. Cot.	c.d.	L. Tan.	L. Sin.	d.	′

P.P.

″	28	27	26
1	0.5	0.4	0.4
2	0.9	0.9	0.9
3	1.4	1.4	1.3
4	1.9	1.8	1.7
5	2.3	2.2	2.2
6	2.8	2.7	2.6
7	3.3	3.2	3.0
8	3.7	3.6	3.5
9	4.2	4.0	3.9
10	4.7	4.5	4.3
20	9.3	9.0	8.7
30	14.0	13.5	13.0
40	18.7	18.0	17.3
50	23.3	22.5	21.7

″	19	18
1	0.3	0.3
2	0.6	0.6
3	1.0	0.9
4	1.3	1.2
5	1.6	1.5
6	1.9	1.8
7	2.2	2.1
8	2.5	2.4
9	2.8	2.7
10	3.2	3.0
20	6.3	6.0
30	9.5	9.0
40	12.7	12.0
50	15.8	15.0

″	9	8
1	0.2	0.1
2	0.3	0.3
3	0.4	0.4
4	0.6	0.5
5	0.8	0.7
6	0.9	0.8
7	1.0	0.9
8	1.2	1.1
9	1.4	1.2
10	1.5	1.3
20	3.0	2.7
30	4.5	4.0
40	6.0	5.3
50	7.5	6.7

	9/28	8/28	8/27
0			
1	1.6	1.8	1.7
2	4.7	5.2	5.1
3	7.8	8.8	8.4
4	10.9	12.2	11.8
5	14.0	15.8	15.2
6	17.1	19.2	18.6
7	20.2	22.8	21.7
8	23.3	26.2	25.3
9	26.4	—	—

P.P.

124° (304°) (235°) **55°**

35° (215°) (324°) **144°**

′	L. Sin.	d.	L. Tan.	c.d.	L. Cot.	L. Cos.	d.	′
0	9.75 859		9.84 523		0.15 477	9.91 336		**60**
1	9.75 877	18	9.84 550	27	0.15 450	9.91 328	8	59
2	9.75 895	18	9.84 576	26	0.15 424	9.91 319	9	58
3	9.75 913	18	9.84 603	27	0.15 397	9.91 310	9	57
4	9.75 931	18	9.84 630	27	0.15 370	9.91 301	9	56
5	9.75 949		9.84 657	27	0.15 343	9.91 292	9	55
6	9.75 967	18	9.84 684	27	0.15 316	9.91 283	9	54
7	9.75 985	18	9.84 711	27	0.15 289	9.91 274	9	53
8	9.76 003	18	9.84 738	27	0.15 262	9.91 266	8	52
9	9.76 021	18	9.84 764	26	0.15 236	9.91 257	9	51
10	9.76 039		9.84 791	27	0.15 209	9.91 248	9	**50**
11	9.76 057	18	9.84 818	27	0.15 182	9.91 239	9	49
12	9.76 075	18	9.84 845	27	0.15 155	9.91 230	9	48
13	9.76 093	18	9.84 872	27	0.15 128	9.91 221	9	47
14	9.76 111	18	9.84 899	27	0.15 101	9.91 212	9	46
15	9.76 129		9.84 925	26	0.15 075	9.91 203	9	45
16	9.76 146	17	9.84 952	27	0.15 048	9.91 194	9	44
17	9.76 164	18	9.84 979	27	0.15 021	9.91 185	9	43
18	9.76 182	18	9.85 006	27	0.14 994	9.91 176	9	42
19	9.76 200	18	9.85 033	27	0.14 967	9.91 167	9	41
20	9.76 218		9.85 059	26	0.14 941	9.91 158	9	**40**
21	9.76 236	18	9.85 086	27	0.14 914	9.91 149	9	39
22	9.76 253	17	9.85 113	27	0.14 887	9.91 141	8	38
23	9.76 271	18	9.85 140	27	0.14 860	9.91 132	9	37
24	9.76 289	18	9.85 166	26	0.14 834	9.91 123	9	36
25	9.76 307	18	9.85 193	27	0.14 807	9.91 114	9	35
26	9.76 324	17	9.85 220	27	0.14 780	9.91 105	9	34
27	9.76 342	18	9.85 247	27	0.14 753	9.91 096	9	33
28	9.76 360	18	9.85 273	26	0.14 727	9.91 087	9	32
29	9.76 378	18	9.85 300	27	0.14 700	9.91 078	9	31
30	9.76 395	17	9.85 327	27	0.14 673	9.91 069	9	**30**
31	9.76 413	18	9.85 354	27	0.14 646	9.91 060	9	29
32	9.76 431	18	9.85 380	26	0.14 620	9.91 051	9	28
33	9.76 448	17	9.85 407	27	0.14 593	9.91 042	9	27
34	9.76 466	18	9.85 434	27	0.14 566	9.91 033	9	26
35	9.76 484	18	9.85 460	26	0.14 540	9.91 023	10	25
36	9.76 501	17	9.85 487	27	0.14 513	9.91 014	9	24
37	9.76 519	18	9.85 514	27	0.14 486	9.91 005	9	23
38	9.76 537	18	9.85 540	26	0.14 460	9.90 996	9	22
39	9.76 554	17	9.85 567	27	0.14 433	9.90 987	9	21
40	9.76 572	18	9.85 594	27	0.14 406	9.90 978	9	**20**
41	9.76 590	18	9.85 620	26	0.14 380	9.90 969	9	19
42	9.76 607	17	9.85 647	27	0.14 353	9.90 960	9	18
43	9.76 625	18	9.85 674	27	0.14 326	9.90 951	9	17
44	9.76 642	17	9.85 700	26	0.14 300	9.90 942	9	16
45	9.76 660	18	9.85 727	27	0.14 273	9.90 933	9	15
46	9.76 677	17	9.85 754	27	0.14 246	9.90 924	9	14
47	9.76 695	18	9.85 780	26	0.14 220	9.90 915	9	13
48	9.76 712	17	9.85 807	27	0.14 193	9.90 906	9	12
49	9.76 730	18	9.85 834	27	0.14 166	9.90 896	10	11
50	9.76 747	17	9.85 860	26	0.14 140	9.90 887	9	**10**
51	9.76 765	18	9.85 887	27	0.14 113	9.90 878	9	9
52	9.76 782	17	9.85 913	26	0.14 087	9.90 869	9	8
53	9.76 800	18	9.85 940	27	0.14 060	9.90 860	9	7
54	9.76 817	17	9.85 967	27	0.14 033	9.90 851	9	6
55	9.76 835	18	9.85 993	26	0.14 007	9.90 842	9	5
56	9.76 852	17	9.86 020	27	0.13 980	9.90 832	10	4
57	9.76 870	18	9.86 046	26	0.13 954	9.90 823	9	3
58	9.76 887	17	9.86 073	27	0.13 927	9.90 814	9	2
59	9.76 904	17	9.86 100	27	0.13 900	9.90 805	9	1
60	9.76 922	18	9.86 126	26	0.13 874	9.90 796	9	**0**
′	L. Cos.	d.	L. Cot.	c.d.	L. Tan.	L. Sin.	d.	′

P.P.

″	**27**	**26**	**18**
1	0.4	0.4	0.3
2	0.9	0.9	0.6
3	1.4	1.3	0.9
4	1.8	1.7	1.2
5	2.2	2.2	1.5
6	2.7	2.6	1.8
7	3.2	3.0	2.1
8	3.6	3.5	2.4
9	4.0	3.9	2.7
10	4.5	4.3	3.0
20	9.0	8.7	6.0
30	13.5	13.0	9.0
40	18.0	17.3	12.0
50	22.5	21.7	15.0

″	**17**	**10**	**9**	**8**
1	0.3	0.2	0.2	0.1
2	0.6	0.3	0.3	0.3
3	0.8	0.5	0.4	0.4
4	1.1	0.7	0.6	0.5
5	1.4	0.8	0.8	0.7
6	1.7	1.0	0.9	0.8
7	2.0	1.2	1.0	0 9
8	2.3	1.3	1.2	1.1
9	2.6	1.5	1.4	1.2
10	2.8	1.7	1.5	1.3
20	5.7	3.3	3.0	2.7
30	8.5	5.0	4.5	4.0
40	11.3	6.7	6.0	5.3
50	14.2	8.3	7.5	6.7

	10/27	**10/26**
0	1.4	1.3
1	4.1	3.9
2	6.8	6.5
3	9.4	9.1
4	12.2	11.7
5	14.8	14.3
6	17.6	16.9
7	20.2	19.5
8	22.9	22.1
9	25.6	24.7
10		

	9/27	**9/26**
0	1.5	1.4
1	4.5	4.3
2	7.5	7.2
3	10.5	10.1
4	13.5	13.0
5	16.5	15.9
6	19.5	18.8
7	22.5	21.7
8	25.5	24.6
9		

P.P.

125° (305°) (234°) **54°**

36° (216°) (323°) **143°**

′	L. Sin.	d.	L. Tan.	c.d.	L. Cot.	L. Cos.	d.	′
0	9.76 922		9.86 126		0.13 874	9.90 796		**60**
1	9.76 939	17	9.86 153	27	0.13 847	9.90 787	9	59
2	9.76 957	18	9.86 179	26	0.13 821	9.90 777	10	58
3	9.76 974	17	9.86 206	27	0.13 794	9.90 768	9	57
4	9.76 991	17	9.86 232	26	0.13 768	9.90 759	9	56
5	9.77 009	18	9.86 259	27	0.13 741	9.90 750	9	55
6	9.77 026	17	9.86 285	26	0.13 715	9.90 741	9	54
7	9.77 043	17	9.86 312	27	0.13 688	9.90 731	10	53
8	9.77 061	18	9.86 338	26	0.13 662	9.90 722	9	52
9	9.77 078	17	9.86 365	27	0.13 635	9.90 713	9	51
10	9.77 095	17	9.86 392	27	0.13 608	9.90 704	9	**50**
11	9.77 112	17	9.86 418	26	0.13 582	9.90 694	10	49
12	9.77 130	18	9.86 445	27	0.13 555	9.90 685	9	48
13	9.77 147	17	9.86 471	26	0.13 529	9.90 676	9	47
14	9.77 164	17	9.86 498	27	0.13 502	9.90 667	9	46
15	9.77 181	17	9.86 524	26	0.13 476	9.90 657	10	45
16	9.77 199	18	9.86 551	27	0.13 449	9.90 648	9	44
17	9.77 216	17	9.86 577	26	0.13 423	9.90 639	9	43
18	9.77 233	17	9.86 603	26	0.13 397	9.90 630	9	42
19	9.77 250	17	9.86 630	27	0.13 370	9.90 620	10	41
20	9.77 268	18	9.86 656	26	0.13 344	9.90 611	9	**40**
21	9.77 285	17	9.86 683	27	0.13 317	9.90 602	9	39
22	9.77 302	17	9.86 709	26	0.13 291	9.90 592	10	38
23	9.77 319	17	9.86 736	27	0.13 264	9.90 583	9	37
24	9.77 336	17	9.86 762	26	0.13 238	9.90 574	9	36
25	9.77 353	17	9.86 789	27	0.13 211	9.90 565	9	35
26	9.77 370	17	9.86 815	26	0.13 185	9.90 555	10	34
27	9.77 387	18	9.86 842	27	0.13 158	9.90 546	9	33
28	9.77 405	17	9.86 868	26	0.13 132	9.90 537	9	32
29	9.77 422	17	9.86 894	26	0.13 106	9.90 527	10	31
30	9.77 439	17	9.86 921	27	0.13 079	9.90 518	9	**30**
31	9.77 456	17	9.86 947	26	0.13 053	9.90 509	9	29
32	9.77 473	17	9.86 974	27	0.13 026	9.90 499	10	28
33	9.77 490	17	9.87 000	26	0.13 000	9.90 490	9	27
34	9.77 507	17	9.87 027	27	0.12 973	9.90 480	10	26
35	9.77 524	17	9.87 053	26	0.12 947	9.90 471	9	25
36	9.77 541	17	9.87 079	26	0.12 921	9.90 462	9	24
37	9.77 558	17	9.87 106	27	0.12 894	9.90 452	10	23
38	9.77 575	17	9.87 132	26	0.12 868	9.90 443	9	22
39	9.77 592	17	9.87 158	26	0.12 842	9.90 434	9	21
40	9.77 609	17	9.87 185	27	0.12 815	9.90 424	10	**20**
41	9.77 626	17	9.87 211	26	0.12 789	9.90 415	9	19
42	9.77 643	17	9.87 238	27	0.12 762	9.90 405	10	18
43	9.77 660	17	9.87 264	26	0.12 736	9.90 396	9	17
44	9.77 677	17	9.87 290	26	0.12 710	9.90 386	10	16
45	9.77 694	17	9.87 317	27	0.12 683	9.90 377	9	15
46	9.77 711	17	9.87 343	26	0.12 657	9.90 368	9	14
47	9.77 728	16	9.87 369	26	0.12 631	9.90 358	10	13
48	9.77 744	17	9.87 396	27	0.12 604	9.90 349	9	12
49	9.77 761	17	9.87 422	26	0.12 578	9.90 339	10	11
50	9.77 778	17	9.87 448	26	0.12 552	9.90 330	9	**10**
51	9.77 795	17	9.87 475	27	0.12 525	9.90 320	10	9
52	9.77 812	17	9.87 501	26	0.12 499	9.90 311	9	8
53	9.77 829	17	9.87 527	26	0.12 473	9.90 301	10	7
54	9.77 846	17	9.87 554	27	0.12 446	9.90 292	9	6
55	9.77 862	16	9.87 580	26	0.12 420	9.90 282	10	5
56	9.77 879	17	9.87 606	26	0.12 394	9.90 273	9	4
57	9.77 896	17	9.87 633	27	0.12 367	9.90 263	10	3
58	9.77 913	17	9.87 659	26	0.12 341	9.90 254	9	2
59	9.77 930	17	9.87 685	26	0.12 315	9.90 244	10	1
60	9.77 946	16	9.87 711	26	0.12 289	9.90 235	9	**0**
′	L. Cos.	d.	L. Cot.	c.d.	L. Tan.	L. Sin.	d.	′

P. P.

	27	26
1	0.4	0.4
2	0.9	0.9
3	1.4	1.3
4	1.8	1.7
5	2.2	2.2
6	2.7	2.6
7	3.2	3.0
8	3.6	3.5
9	4.0	3.9
10	4.5	4.3
20	9.0	8.7
30	13.5	13.0
40	18.0	17.3
50	22.5	21.7

	18	17	16
1	0.3	0.3	0.3
2	0.6	0.6	0.5
3	0.9	0.8	0.8
4	1.2	1.1	1.1
5	1.5	1.4	1.3
6	1.8	1.7	1.6
7	2.1	2.0	1.9
8	2.4	2.3	2.1
9	2.7	2.6	2.4
10	3.0	2.8	2.7
20	6.0	5.7	5.3
30	9.0	8.5	8.0
40	12.0	11.3	10.7
50	15.0	14.2	13.3

	10	9
1	0.2	0.2
2	0.3	0.3
3	0.5	0.4
4	0.7	0.6
5	0.8	0.8
6	1.0	0.9
7	1.2	1.0
8	1.3	1.2
9	1.5	1.4
10	1.7	1.5
20	3.3	3.0
30	5.0	4.5
40	6.7	6.0
50	8.3	7.5

	9/27	9/26
0	1.5	1.4
1	4.5	4.3
2	7.5	7.2
3	10.5	10.1
4	13.5	13.0
5	16.5	15.9
6	19.5	18.8
7	22.5	21.7
8	25.5	24.6
9		

P. P.

126° (306°) (233°) **53°**

37° (217°) (322°) **142°**

′	L. Sin.	d.	L. Tan.	c.d.	L. Cot.	L. Cos.	d.	′
0	9.77 946		9.87 711		0.12 289	9.90 235		**60**
1	9.77 963	17	9.87 738	27	0.12 262	9.90 225	10	59
2	9.77 980	17	9.87 764	26	0.12 236	9.90 216	9	58
3	9.77 997	17	9.87 790	26	0.12 210	9.90 206	10	57
4	9.78 013	16	9.87 817	27	0.12 183	9.90 197	9	56
5	9.78 030	17	9.87 843	26	0.12 157	9.90 187	10	55
6	9.78 047	17	9.87 869	26	0.12 131	9.90 178	9	54
7	9.78 063	16	9.87 895	26	0.12 105	9.90 168	10	53
8	9.78 080	17	9.87 922	27	0.12 078	9.90 159	9	52
9	9.78 097	17	9.87 948	26	0.12 052	9.90 149	10	51
10	9.78 113	16	9.87 974	26	0.12 026	9.90 139	10	**50**
11	9.78 130	17	9.88 000	26	0.12 000	9.90 130	9	49
12	9.78 147	17	9.88 027	27	0.11 973	9.90 120	10	48
13	9.78 163	16	9.88 053	26	0.11 947	9.90 111	9	47
14	9.78 180	17	9.88 079	26	0.11 921	9.90 101	10	46
15	9.78 197	17	9.88 105	26	0.11 895	9.90 091	10	45
16	9.78 213	16	9.88 131	26	0.11 869	9.90 082	9	44
17	9.78 230	17	9.88 158	27	0.11 842	9.90 072	10	43
18	9.78 246	16	9.88 184	26	0.11 816	9.90 063	9	42
19	9.78 263	17	9.88 210	26	0.11 790	9.90 053	10	41
20	9.78 280	17	9.88 236	26	0.11 764	9.90 043	10	**40**
21	9.78 296	16	9.88 262	26	0.11 738	9.90 034	9	39
22	9.78 313	17	9.88 289	27	0.11 711	9.90 024	10	38
23	9.78 329	16	9.88 315	26	0.11 685	9.90 014	10	37
24	9.78 346	17	9.88 341	26	0.11 659	9.90 005	9	36
25	9.78 362	16	9.88 367	26	0.11 633	9.89 995	10	35
26	9.78 379	17	9.88 393	26	0.11 607	9.89 985	10	34
27	9.78 395	16	9.88 420	27	0.11 580	9.89 679	9	33
28	9.78 412	17	9.88 446	26	0.11 554	9.89 966	10	32
29	9.78 428	16	9.88 472	26	0.11 528	9.89 956	10	31
30	9.78 445	17	9.88 498	26	0.11 502	9.89 947	9	**30**
31	9.78 461	16	9.88 524	26	0.11 476	9.89 937	10	29
32	9.78 478	17	9.88 550	27	0.11 450	9.89 927	10	28
33	9.78 494	16	9.88 577	26	0.11 423	9.89 918	9	27
34	9.78 510	16	9.88 603	26	0.11 397	9.89 908	10	26
35	9.78 527	17	9.88 629	26	0.11 371	9.89 898	10	25
36	9.78 543	16	9.88 655	26	0.11 345	9.89 888	10	24
37	9.78 560	17	9.88 681	26	0.11 319	9.89 879	9	23
38	9.78 576	16	9.88 707	26	0.11 293	9.89 869	10	22
39	9.78 592	16	9.88 733	26	0.11 267	9.89 859	10	21
40	9.78 609	17	9.88 759	26	0.11 241	9.89 849	10	**20**
41	9.78 625	16	9.88 786	27	0.11 214	9.89 840	9	19
42	9.78 642	17	9.88 812	26	0.11 188	9.89 830	10	18
43	9.78 658	16	9.88 838	26	0.11 162	9.89 820	10	17
44	9.78 674	16	9.88 864	26	0.11 136	9.89 810	10	16
45	9.78 691	17	9.88 890	26	0.11 110	9.89 801	9	15
46	9.78 707	16	9.88 916	26	0.11 084	9.89 791	10	14
47	9.78 723	16	9.88 942	26	0.11 058	9.89 781	10	13
48	9.78 739	16	9.88 968	26	0.11 032	9.89 771	10	12
49	9.78 756	17	9.88 994	26	0.11 006	9.89 761	10	11
50	9.78 772	16	9.89 020	26	0.10 980	9.89 752	9	**10**
51	9.78 788	16	9.89 046	26	0.10 954	9.89 742	10	9
52	9.78 805	17	9.89 073	27	0.10 927	9.89 732	10	8
53	9.78 821	16	9.89 099	26	0.10 901	9.89 722	10	7
54	9.78 837	16	9.89 125	26	0.10 875	9.89 712	10	6
55	9.78 853	16	9.89 151	26	0.10 849	9.89 702	10	5
56	9.78 869	16	9.89 177	26	0.10 823	9.89 692	9	4
57	9.78 886	17	9.89 203	26	0.10 797	9.89 683	10	3
58	9.78 902	16	9.89 229	26	0.10 771	9.89 673	10	2
59	9.78 918	16	9.89 255	26	0.10 745	9.89 663	10	1
60	9.78 934		9.89 281		0.10 719	9.89 653	10	**0**
′	L. Cos.	d.	L. Cot.	c.d.	L. Tan.	L. Sin.	d.	′

P. P.

″	27	26
1	0.4	0.4
2	0.9	0.9
3	1.4	1.3
4	1.8	1.7
5	2.2	2.2
6	2.7	2.6
7	3.2	3.0
8	3.6	3.5
9	4.0	3.9
10	4.5	4.3
20	9.0	8.7
30	13.5	13.0
40	18.0	17.3
50	22.5	21.7

″	17	16
1	0.3	0.3
2	0.6	0.5
3	0.8	0.8
4	1.1	1.1
5	1.4	1.3
6	1.7	1.6
7	2.0	1.9
8	2.3	2.1
9	2.6	2.4
10	2.8	2.7
20	5.7	5.3
30	8.5	8.0
40	11.3	10.7
50	14.2	13.3

″	10	9
1	0.2	0.2
2	0.3	0.3
3	0.5	0.4
4	0.7	0.6
5	0.8	0.8
6	1.0	0.9
7	1.2	1.0
8	1.3	1.2
9	1.5	1.4
10	1.7	1.5
20	3.3	3.0
30	5.0	4.5
40	6.7	6.0
50	8.3	7.5

	10	10
	27	26
0	1.4	1.3
1	4.1	3.9
2	6.8	6.5
3	9.4	9.1
4	12.2	11.7
5	14.8	14.3
6	17.6	16.9
7	20.2	19.5
8	22.9	22.1
9	25.6	24.7
10		

P. P.

127° (307°) (232°) **52°**

38° (218°) (321°) **141°**

′	L. Sin.	d.	L. Tan.	c.d.	L. Cot.	L. Cos.	d.	′
0	9.78 934		9.89 281		0.10 719	9.89 653		**60**
1	9.78 950	16	9.89 307	26	0.10 693	9.89 643	10	59
2	9.78 967	17	9.89 333	26	0.10 667	9.89 633	10	58
3	9.78 983	16	9.89 359	26	0.10 641	9.89 624	9	57
4	9.78 999	16	9.89 385	26	0.10 615	9.89 614	10	56
5	9.79 015	16	9.89 411	26	0.10 589	9.89 604	10	55
6	9.79 031	16	9.89 437	26	0.10 563	9.89 594	10	54
7	9.79 047	16	9.89 463	26	0.10 537	9.89 584	10	53
8	9.79 063	16	9.89 489	26	0.10 511	9.89 574	10	52
9	9.79 079	16	9.89 515	26	0.10 485	9.89 564	10	51
10	9.79 095	16	9.89 541	26	0.10 459	9.89 554	10	**50**
11	9.79 111	16	9.89 567	26	0.10 433	9.89 544	10	49
12	9.79 128	17	9.89 593	26	0.10 407	9.89 534	10	48
13	9.79 144	16	9.89 619	26	0.10 381	9.89 524	10	47
14	9.79 160	16	9.89 645	26	0.10 355	9.89 514	10	46
15	9.79 176	16	9.89 671	26	0.10 329	9.89 504	9	45
16	9.79 192	16	9.89 697	26	0.10 303	9.89 495	10	44
17	9.79 208	16	9.89 723	26	0.10 277	9.89 485	10	43
18	9.79 224	16	9.89 749	26	0.10 251	9.89 475	10	42
19	9.79 240	16	9.89 775	26	0.10 225	9.89 465	10	41
20	9.79 256	16	9.89 801	26	0.10 199	9.89 455	10	**40**
21	9.79 272	16	9.89 827	26	0.10 173	9.89 445	10	39
22	9.79 288	16	9.89 853	26	0.10 147	9.89 435	10	38
23	9.79 304	16	9.89 879	26	0.10 121	9.89 425	10	37
24	9.79 319	15	9.89 905	26	0.10 095	9.89 415	10	36
25	9.79 335	16	9.89 931	26	0.10 069	9.89 405	10	35
26	9.79 351	16	9.89 957	26	0.10 043	9.89 395	10	34
27	9.79 367	16	9.89 983	26	0.10 017	9.89 385	10	33
28	9.79 383	16	9.90 009	26	0.09 991	9.89 375	10	32
29	9.79 399	16	9.90 035	26	0.09 965	9.89 364	11	31
30	9.79 415	16	9.90 061	25	0.09 939	9.89 354	10	**30**
31	9.79 431	16	9.90 086	26	0.09 914	9.89 344	10	29
32	9.79 447	16	9.90 112	26	0.09 888	9.89 334	10	28
33	9.79 463	16	9.90 138	26	0.09 862	9.89 324	10	27
34	9.79 478	15	9.90 164	26	0.09 836	9.89 314	10	26
35	9.79 494	16	9.90 190	26	0.09 810	9.89 304	10	25
36	9.79 510	16	9.90 216	26	0.09 784	9.89 294	10	24
37	9.79 526	16	9.90 242	26	0.09 758	9.89 284	10	23
38	9.79 542	16	9.90 268	26	0.09 732	9.89 274	10	22
39	9.79 558	16	9.90 294	26	0.09 706	9.89 264	10	21
40	9.79 573	15	9.90 320	26	0.09 680	9.89 254	10	**20**
41	9.79 589	16	9.90 346	26	0.09 654	9.89 244	10	19
42	9.79 605	16	9.90 371	25	0.09 629	9.89 233	11	18
43	9.79 621	16	9.90 397	26	0.09 603	9.89 223	10	17
44	9.79 636	15	9.90 423	26	0.09 577	9.89 213	10	16
45	9.79 652	16	9.90 449	26	0.09 551	9.89 203	10	15
46	9.79 668	16	9.90 475	26	0.09 525	9.89 193	10	14
47	9.79 684	16	9.90 501	26	0.09 499	9.89 183	10	13
48	9.79 699	15	9.90 527	26	0.09 473	9.89 173	10	12
49	9.79 715	16	9.90 553	25	0.09 447	9.89 162	11	11
50	9.79 731	16	9.90 578	26	0.09 422	9.89 152	10	**10**
51	9.79 746	15	9.90 604	26	0.09 396	9.89 142	10	9
52	9.79 762	16	9.90 630	26	0.09 370	9.89 132	10	8
53	9.79 778	16	9.90 656	26	0.09 344	9.89 122	10	7
54	9.79 793	15	9.90 682	26	0.09 318	9.89 112	10	6
55	9.79 809	16	9.90 708	26	0.09 292	9.89 101	11	5
56	9.79 825	16	9.90 734	26	0.09 266	9.89 091	10	4
57	9.79 840	15	9.90 759	25	0.09 241	9.89 081	10	3
58	9.79 856	16	9.90 785	26	0.09 215	9.89 071	10	2
59	9.79 872	16	9.90 811	26	0.09 189	9.89 060	11	1
60	9.79 887	15	9.90 837	26	0.09 163	9.89 050	10	**0**
′	L. Cos.	d.	L. Cot.	c.d.	L. Tan.	L. Sin.	d.	′

P. P.			
″	**26**	**25**	
1	0.4	0.4	
2	0.9	0.8	
3	1.3	1.2	
4	1.7	1.7	
5	2.2	2.1	
6	2.6	2.5	
7	3.0	2.9	
8	3.5	3.3	
9	3.9	3.8	
10	4.3	4.2	
20	8.7	8.3	
30	13.0	12.5	
40	17.3	16.7	
50	21.7	20.8	

P. P.			
″	**17**	**16**	**15**
1	0.3	0.3	0.2
2	0.6	0.5	0.5
3	0.8	0.8	0.8
4	1.1	1.1	1.0
5	1.4	1.3	1.2
6	1.7	1.6	1.5
7	2.0	1.9	1.8
8	2.3	2.1	2.0
9	2.6	2.4	2.2
10	2.8	2.7	2.5
20	5.7	5.3	5.0
30	8.5	8.0	7.5
40	11.3	10.7	10.0
50	14.2	13.3	12.5

P. P.			
″	**11**	**10**	**9**
1	0.2	0.2	0.2
2	0.4	0.3	0.3
3	0.6	0.5	0.4
4	0.7	0.7	0.6
5	0.9	0.8	0.8
6	1.1	1.0	0.9
7	1.3	1.2	1.0
8	1.5	1.3	1.2
9	1.6	1.5	1.4
10	1.8	1.7	1.5
20	3.7	3.3	3.0
30	5.5	5.0	4.5
40	7.3	6.7	6.0
50	9.2	8.3	7.5

P. P.			
	10	**10**	**9**
	26	**25**	**26**
0	1.3	1.2	1.4
1	3.9	3.8	4.3
2	6.5	6.2	7.2
3	9.1	8.8	10.1
4	11.7	11.2	13.0
5	14.3	13.8	15.9
6	16.9	16.2	18.8
7	19.5	18.8	21.7
8	22.1	21.2	24.6
9	24.7	23.8	—
10			

128° (308°) (231°) **51°**

39° (219°) (320°) **140°**

′	L. Sin.	d.	L. Tan.	c.d.	L. Cot.	L. Cos.	d.	′
0	9.79 887		9.90 837		0.09 163	9.89 050		**60**
1	9.79 903	16	9.90 863	26	0.09 137	9.89 040	10	59
2	9.79 918	15	9.90 889	26	0.09 111	9.89 030	10	58
3	9.79 934	16	9.90 914	25	0.09 086	9.89 020	10	57
4	9.79 950	16	9.90 940	26	0.09 060	9.89 009	11	56
5	9.79 965	15	9.90 966	26	0.09 034	9.88 999	10	55
6	9.79 981	16	9.90 992	26	0.09 008	9.88 989	10	54
7	9.79 996	15	9.91 018	26	0.08 982	9.88 978	11	53
8	9.80 012	16	9.91 043	25	0.08 957	9.88 968	10	52
9	9.80 027	15	9.91 069	26	0.08 931	9.88 958	10	51
10	9.80 043	16	9.91 095	26	0.08 905	9.88 948	10	**50**
11	9.80 058	15	9.91 121	26	0.08 879	9.88 937	11	49
12	9.80 074	16	9.91 147	26	0.08 853	9.88 927	10	48
13	9.80 089	15	9.91 172	25	0.08 828	9.88 917	10	47
14	9.80 105	16	9.91 198	26	0.08 802	9.88 906	11	46
15	9.80 120	15	9.91 224	26	0.08 776	9.88 896	10	45
16	9.80 136	16	9.91 250	26	0.08 750	9.88 886	10	44
17	9.80 151	15	9.91 276	26	0.08 724	9.88 875	11	43
18	9.80 166	15	9.91 301	25	0.08 699	9.88 865	10	42
19	9.80 182	16	9.91 327	26	0.08 673	9.88 855	10	41
20	9.80 197	15	9.91 353	26	0.08 647	9.88 844	11	**40**
21	9.80 213	16	9.91 379	26	0.08 621	9.88 834	10	39
22	9.80 228	15	9.91 404	25	0.08 596	9.88 824	10	38
23	9.80 244	16	9.91 430	26	0.08 570	9.88 813	11	37
24	9.80 259	15	9.91 456	26	0.08 544	9.88 803	10	36
25	9.80 274	15	9.91 482	26	0.08 518	9.88 793	10	35
26	9.80 290	16	9.91 507	25	0.08 493	9.88 782	11	34
27	9.80 305	15	9.91 533	26	0.08 467	9.88 772	10	33
28	9.80 320	15	9.91 559	26	0.08 441	9.88 761	11	32
29	9.80 336	16	9.91 585	26	0.08 415	9.88 751	10	31
30	9.80 351	15	9.91 610	25	0.08 390	9.88 741	10	**30**
31	9.80 366	15	9.91 636	26	0.08 364	9.88 730	11	29
32	9.80 382	16	9.91 662	26	0.08 338	9.88 720	10	28
33	9.80 397	15	9.91 688	26	0.08 312	9.88 709	11	27
34	9.80 412	15	9.91 713	25	0.08 287	9.88 699	10	26
35	9.80 428	16	9.91 739	26	0.08 261	9.88 688	11	25
36	9.80 443	15	9.91 765	26	0.08 235	9.88 678	10	24
37	9.80 458	15	9.91 791	26	0.08 209	9.88 668	10	23
38	9.80 473	15	9.91 816	25	0.08 184	9.88 657	11	22
39	9.80 489	16	9.91 842	26	0.08 158	9.88 647	10	21
40	9.80 504	15	9.91 868	26	0.08 132	9.88 636	11	**20**
41	9.80 519	15	9.91 893	25	0.08 107	9.88 626	10	19
42	9.80 534	15	9.91 919	26	0.08 081	9.88 615	11	18
43	9.80 550	16	9.91 945	26	0.08 055	9.88 605	10	17
44	9.80 565	15	9.91 971	26	0.08 029	9.88 594	11	16
45	9.80 580	15	9.91 996	25	0.08 004	9.88 584	10	15
46	9.80 595	15	9.92 022	26	0.07 978	9.88 573	11	14
47	9.80 610	15	9.92 048	26	0.07 952	9.88 563	10	13
48	9.80 625	15	9.92 073	25	0.07 927	9.88 552	11	12
49	9.80 641	16	9.92 099	26	0.07 901	9.88 542	11	11
50	9.80 656	15	9.92 125	26	0.07 875	9.88 531	11	**10**
51	9.80 671	15	9.92 150	25	0.07 850	9.88 521	10	9
52	9.80 686	15	9.92 176	26	0.07 824	9.88 510	11	8
53	9.80 701	15	9.92 202	26	0.07 798	9.88 499	11	7
54	9.80 716	15	9.92 227	25	0.07 773	9.88 489	10	6
55	9.80 731	15	9.92 253	26	0.07 747	9.88 478	11	5
56	9.80 746	15	9.92 279	26	0.07 721	9.88 468	10	4
57	9.80 762	16	9.92 304	25	0.07 696	9.88 457	11	3
58	9.80 777	15	9.92 330	26	0.07 670	9.88 447	10	2
59	9.80 792	15	9.92 356	26	0.07 644	9.88 436	11	1
60	9.80 807	15	9.92 381	25	0.07 619	9.88 425	11	**0**
′	L. Cos.	d.	L. Cot.	c.d.	L. Tan.	L. Sin.	d.	′

P. P.		
″	**26**	**25**
1	0.4	0.4
2	0.9	0.8
3	1.3	1.2
4	1.7	1.7
5	2.2	2.1
6	2.6	2.5
7	3.0	2.9
8	3.5	3.3
9	3.9	3.8
10	4.3	4.2
20	8.7	8.3
30	13.0	12.5
40	17.3	16.7
50	21.7	20.8

P. P.		
″	**16**	**15**
1	0.3	0.2
2	0.5	0.5
3	0.8	0.8
4	1.1	1.0
5	1.3	1.2
6	1.6	1.5
7	1.9	1.8
8	2.1	2.0
9	2.4	2.2
10	2.7	2.5
20	5.3	5.0
30	8.0	7.5
40	10.7	10.0
50	13.3	12.5

P. P.		
″	**11**	**10**
1	0.2	0.2
2	0.4	0.3
3	0.6	0.5
4	0.7	0.7
5	0.9	0.8
6	1.1	1.0
7	1.3	1.2
8	1.5	1.3
9	1.6	1.5
10	1.8	1.7
20	3.7	3.3
30	5.5	5.0
40	7.3	6.7
50	9.2	8.3

P. P.		
	11	**11**
	26	**25**
0	1.2	1.1
1	3.5	3.4
2	5.9	5.7
3	8.3	7.9
4	10.6	10.2
5	13.0	12.5
6	15.4	14.8
7	17.7	17.1
8	20.1	19.3
9	22.5	21.6
10	24.8	23.9
11		

P. P.

129° (309°) (230°) **50°**

40° (220°) (319°) **139°**

′	L. Sin.	d.	L. Tan.	c.d.	L. Cot.	L. Cos.	d.	′
0	9.80 807		9.92 381		0.07 619	9.88 425		**60**
1	9.80 822	15	9.92 407	26	0.07 593	9.88 415	10	59
2	9.80 837	15	9.92 433	26	0.07 567	9.88 404	11	58
3	9.80 852	15	9.92 458	25	0.07 542	9.88 394	10	57
4	9.80 867	15	9.92 484	26	0.07 516	9.88 383	11	56
5	9.80 882	15	9.92 510	26	0.07 490	9.88 372	11	55
6	9.80 897	15	9.92 535	25	0.07 465	9.88 362	10	54
7	9.80 912	15	9.92 561	26	0.07 439	9.88 351	11	53
8	9.80 927	15	9.92 587	26	0.07 413	9.88 340	11	52
9	9.80 942	15	9.92 612	25	0.07 388	9.88 330	10	51
10	9.80 957	15	9.92 638	26	0.07 362	9.88 319	11	**50**
11	9.80 972	15	9.92 663	25	0.07 337	9.88 308	11	49
12	9.80 987	15	9.92 689	26	0.07 311	9.88 298	10	48
13	9.81 002	15	9.92 715	26	0.07 285	9.88 287	11	47
14	9.81 017	15	9.92 740	25	0.07 260	9.88 276	11	46
15	9.81 032	15	9.92 766	26	0.07 234	9.88 266	10	45
16	9.81 047	15	9.92 792	26	0.07 208	9.88 255	11	44
17	9.81 061	14	9.92 817	25	0.07 183	9.88 244	11	43
18	9.81 076	15	9.92 843	26	0.07 157	9.88 234	10	42
19	9.81 091	15	9.92 868	25	0.07 132	9.88 223	11	41
20	9.81 106	15	9.92 894	26	0.07 106	9.88 212	11	**40**
21	9.81 121	15	9.92 920	26	0.07 080	9.88 201	11	39
22	9.81 136	15	9.92 945	25	0.07 055	9.88 191	10	38
23	9.81 151	15	9.92 971	26	0.07 029	9.88 180	11	37
24	9.81 166	15	9.92 996	25	0.07 004	9.88 169	11	36
25	9.81 180	14	9.93 022	26	0.06 978	9.88 158	11	35
26	9.81 195	15	9.93 048	26	0.06 952	9.88 148	10	34
27	9.81 210	15	9.93 073	25	0.06 927	9.88 137	11	33
28	9.81 225	15	9.93 099	26	0.06 901	9.88 126	11	32
29	9.81 240	15	9.93 124	25	0.06 876	9.88 115	11	31
30	9.81 254	14	9.93 150	26	0.06 850	9.88 105	10	**30**
31	9.81 269	15	9.93 175	25	0.06 825	9.88 094	11	29
32	9.81 284	15	9.93 201	26	0.06 799	9.88 083	11	28
33	9.81 299	15	9.93 227	26	0.06 773	9.88 072	11	27
34	9.81 314	15	9.93 252	25	0.06 748	9.88 061	11	26
35	9.81 328	14	9.93 278	26	0.06 722	9.88 051	10	25
36	9.81 343	15	9.93 303	25	0.06 697	9.88 040	11	24
37	9.81 358	15	9.93 329	26	0.06 671	9.88 029	11	23
38	9.81 372	14	9.93 354	25	0.06 646	9.88 018	11	22
39	9.81 387	15	9.93 380	26	0.06 620	9.88 007	11	21
40	9.81 402	15	9.93 406	26	0.06 594	9.87 996	11	**20**
41	9.81 417	15	9.93 431	25	0.06 569	9.87 985	11	19
42	9.81 431	14	9.93 457	26	0.06 543	9.87 975	10	18
43	9.81 446	15	9.93 482	25	0.06 518	9.87 964	11	17
44	9.81 461	15	9.93 508	26	0.06 492	9.87 953	11	16
45	9.81 475	14	9.93 533	25	0.06 467	9.87 942	11	15
46	9.81 490	15	9.93 559	26	0.06 441	9.87 931	11	14
47	9.81 505	15	9.93 584	25	0.06 416	9.87 920	11	13
48	9.81 519	14	9.93 610	26	0.06 390	9.87 909	11	12
49	9.81 534	15	9.93 636	26	0.06 364	9.87 898	11	11
50	9.81 549	15	9.93 661	25	0.06 339	9.87 887	11	**10**
51	9.81 563	14	9.93 687	26	0.06 313	9.87 877	10	9
52	9.81 578	15	9.93 712	25	0.06 288	9.87 866	11	8
53	9.81 592	14	9.93 738	26	0.06 262	9.87 855	11	7
54	9.81 607	15	9.93 763	25	0.06 237	9.87 844	11	6
55	9.81 622	15	9.93 789	26	0.06 211	9.87 833	11	5
56	9.81 636	14	9.93 814	25	0.06 186	9.87 822	11	4
57	9.81 651	15	9.93 840	26	0.06 160	9.87 811	11	3
58	9.81 665	14	9.93 865	25	0.06 135	9.87 800	11	2
59	9.81 680	15	9.93 891	26	0.06 109	9.87 789	11	1
60	9.81 694	14	9.93 916	25	0.06 084	9.87 778	11	**0**
′	L. Cos.	d.	L. Cot.	c.d.	L. Tan.	L. Sin.	d.	′

P. P.		
″	**26**	**25**
1	0.4	0.4
2	0.9	0.8
3	1.3	1.2
4	1.7	1.7
5	2.2	2.1
6	2.6	2.5
7	3.0	2.9
8	3.5	3.3
9	3.9	3.8
10	4.3	4.2
20	8.7	8.3
30	13.0	12.5
40	17.3	16.7
50	21.7	20.8

P. P.		
″	**15**	**14**
1	0.2	0.2
2	0.5	0.5
3	0.8	0.7
4	1.0	0.9
5	1.2	1.2
6	1.5	1.4
7	1.8	1.6
8	2.0	1.9
9	2.2	2.1
10	2.5	2.3
20	5.0	4.7
30	7.5	7.0
40	10.0	9.3
50	12.5	11.7

P. P.			
″	**11**	**10**	
1	0.2	0.2	
2	0.4	0.3	
3	0.6	0.5	
4	0.7	0.7	
5	0.9	0.8	
6	1.1	1.0	
7	1.3	1.2	
8	1.5	1.3	
9	1.6	1.5	
10	1.8	1.7	
20	3.7	3.3	
30	5.5	5.0	
40	7.3	6.7	
50	9.2	8.3	

	11	**10**	**10**
	26	**26**	**25**
0	1.2	1.3	1.2
1	3.5	3.9	3.8
2	5.9	6.5	6.2
3	8.3	9.1	8.8
4	10.6	11.7	11.2
5	13.0	14.3	13.8
6	15.4	16.9	16.2
7	17.7	19.5	18.8
8	20.1	22.1	21.2
9	22.5	24.7	23.8
10	24.8	—	—
11			

P. P.

130° (310°) (229°) **49°**

41° (221°) **(318°) 138°**

′	L. Sin.	d.	L. Tan.	c.d.	L. Cot.	L. Cos.	d.	′
0	9.81 694		9.93 916		0.06 084	9.87 778		**60**
1	9.81 709	15	9.93 942	26	0.06 058	9.87 767	11	59
2	9.81 723	14	9.93 967	25	0.06 033	9.87 756	11	58
3	9.81 738	15	9.93 993	26	0.06 007	9.87 745	11	57
4	9.81 752	14	9.94 018	25	0.05 982	9.87 734	11	56
5	9.81 767	15	9.94 044	26	0.05 956	9.87 723	11	55
6	9.81 781	14	9.94 069	25	0.05 931	9.87 712	11	54
7	9.81 796	15	9.94 095	26	0.05 905	9.87 701	11	53
8	9.81 810	14	9.94 120	25	0.05 880	9.87 690	11	52
9	9.81 825	15	9.94 146	26	0.05 854	9.87 679	11	51
10	9.81 839	14	9.94 171	25	0.05 829	9.87 668	11	**50**
11	9.81 854	15	9.94 197	26	0.05 803	9.87 657	11	49
12	9.81 868	14	9.94 222	25	0.05 778	9.87 646	11	48
13	9.81 882	14	9.94 248	26	0.05 752	9.87 635	11	47
14	9.81 897	15	9.94 273	25	0.05 727	9.87 624	11	46
15	9.81 911	14	9.94 299	26	0.05 701	9.87 613	11	45
16	9.81 926	15	9.94 324	25	0.05 676	9.87 601	12	44
17	9.81 940	14	9.94 350	26	0.05 650	9.87 590	11	43
18	9.81 955	15	9.94 375	25	0.05 625	9.87 579	11	42
19	9.81 969	14	9.94 401	26	0.05 599	9.87 568	11	41
20	9.81 983	14	9.94 426	25	0.05 574	9.87 557	11	**40**
21	9.81 998	15	9.94 452	26	0.05 548	9.87 546	11	39
22	9.82 012	14	9.94 477	25	0.05 523	9.87 535	11	38
23	9.82 026	14	9.94 503	26	0.05 497	9.87 524	11	37
24	9.82 041	15	9.94 528	25	0.05 472	9.87 513	11	36
25	9.82 055	14	9.94 554	26	0.05 446	9.87 501	12	35
26	9.82 069	14	9.94 579	25	0.05 421	9.87 490	11	34
27	9.82 084	15	9.94 604	25	0.05 396	9.87 479	11	33
28	9.82 098	14	9.94 630	26	0.05 370	9.87 468	11	32
29	9.82 112	14	9.94 655	25	0.05 345	9.87 457	11	31
30	9.82 126	14	9.94 681	26	0.05 319	9.87 446	11	**30**
31	9.82 141	15	9.94 706	25	0.05 294	9.87 434	12	29
32	9.82 155	14	9.94 732	26	0.05 268	9.87 423	11	28
33	9.82 169	14	9.94 757	25	0.05 243	9.87 412	11	27
34	9.82 184	15	9.94 783	26	0.05 217	9.87 401	11	26
35	9.82 198	14	9.94 808	25	0.05 192	9.87 390	11	25
36	9.82 212	14	9.94 834	26	0.05 166	9.87 378	12	24
37	9.82 226	14	9.94 859	25	0.05 141	9.87 367	11	23
38	9.82 240	14	9.94 884	25	0.05 116	9.87 356	11	22
39	9.82 255	15	9.94 910	26	0.05 090	9.87 345	11	21
40	9.82 269	14	9.94 935	25	0.05 065	9.87 334	11	**20**
41	9.82 283	14	9.94 961	26	0.05 039	9.87 322	12	19
42	9.82 297	14	9.94 986	25	0.05 014	9.87 311	11	18
43	9.82 311	14	9.95 012	26	0.04 988	9.87 300	11	17
44	9.82 326	15	9.95 037	25	0.04 963	9.87 288	12	16
45	9.82 340	14	9.95 062	25	0.04 938	9.87 277	11	15
46	9.82 354	14	9.95 088	26	0.04 912	9.87 266	11	14
47	9.82 368	14	9.95 113	25	0.04 887	9.87 255	11	13
48	9.82 382	14	9.95 139	26	0.04 861	9.87 243	12	12
49	9.82 396	14	9.95 164	25	0.04 836	9.87 232	11	11
50	9.82 410	14	9.95 190	26	0.04 810	9.87 221	11	**10**
51	9.82 424	14	9.95 215	25	0.04 785	9.87 209	12	9
52	9.82 439	15	9.95 240	25	0.04 760	9.87 198	11	8
53	9.82 453	14	9.95 266	26	0.04 734	9.87 187	11	7
54	9.82 467	14	9.95 291	25	0.04 709	9.87 175	12	6
55	9.82 481	14	9.95 317	26	0.04 683	9.87 164	11	5
56	9.82 495	14	9.95 342	25	0.04 658	9.87 153	11	4
57	9.82 509	14	9.95 368	26	0.04 632	9.87 141	12	3
58	9.82 523	14	9.95 393	25	0.04 607	9.87 130	11	2
59	9.82 537	14	9.95 418	25	0.04 582	9.87 119	11	1
60	9.82 551	14	9.95 444	26	0.04 556	9.87 107	12	**0**
′	L. Cos.	d.	L. Cot.	c.d.	L. Tan.	L. Sin.	d.	′

′	P. P.	
	26	**25**
1	0.4	0.4
2	0.9	0.8
3	1.3	1.2
4	1.7	1.7
5	2.2	2.1
6	2.6	2.5
7	3.0	2.9
8	3.5	3.3
9	3.9	3.8
10	4.3	4.2
20	8.7	8.3
30	13.0	12.5
40	17.3	16.7
50	21.7	20.8

″	**15**	**14**
1	0.2	0.2
2	0.5	0.5
3	0.8	0.7
4	1.0	0.9
5	1.2	1.2
6	1.5	1.4
7	1.8	1.6
8	2.0	1.9
9	2.2	2.1
10	2.5	2.3
20	5.0	4.7
30	7.5	7.0
40	10.0	9.3
50	12.5	11.7

″	**12**	**11**
1	0.2	0.2
2	0.4	0.4
3	0.6	0.6
4	0.8	0.7
5	1.0	0.9
6	1.2	1.1
7	1.4	1.3
8	1.6	1.5
9	1.8	1.6
10	2.0	1.8
20	4.0	3.7
30	6.0	5.5
40	8.0	7.3
50	10.0	9.2

	12	**12**	**11**
	26	**25**	**25**
0	1.1	1.1	1.1
1	3.2	3.1	3.4
2	5.4	5.2	5.7
3	7.6	7.3	7.9
4	9.8	9.4	10.2
5	11.9	11.5	12.5
6	14.1	13.5	14.8
7	16.2	15.6	17.1
8	18.4	17.7	19.3
9	20.6	19.8	21.6
10	22.8	21.9	23.9
11	24.9	23.9	—
12			

′	P. P.

131° (311°) **(228°) 48°**

42° (222°) (317°) **137°**

′	L. Sin.	d.	L. Tan.	c.d.	L. Cot.	L. Cos.	d.	′
0	9.82 551		9.95 444		0.04 556	9.87 107		**60**
1	9.82 565	14	9.95 469	25	0.04 531	9.87 096	11	59
2	9.82 579	14	9.95 495	26	0.04 505	9.87 085	11	58
3	9.82 593	14	9.95 520	25	0.04 480	9.87 073	12	57
4	9.82 607	14	9.95 545	25	0.04 455	9.87 062	11	56
5	9.82 621	14	9.95 571	26	0.04 429	9.87 050	12	55
6	9.82 635	14	9.95 596	25	0.04 404	9.87 039	11	54
7	9.82 649	14	9.95 622	26	0.04 378	9.87 028	11	53
8	9.82 663	14	9.95 647	25	0.04 353	9.87 016	12	52
9	9.82 677	14	9.95 672	25	0.04 328	9.87 005	11	51
10	9.82 691	14	9.95 698	26	0.04 302	9.86 993	12	**50**
11	9.82 705	14	9.95 723	25	0.04 277	9.86 982	11	49
12	9.82 719	14	9.95 748	25	0.04 252	9.86 970	12	48
13	9.82 733	14	9.95 774	26	0.04 226	9.86 959	11	47
14	9.82 747	14	9.95 799	25	0.04 201	9.86 947	12	46
15	9.82 761	14	9.95 825	26	0.04 175	9.86 936	11	45
16	9.82 775	14	9.95 850	25	0.04 150	9.86 924	12	44
17	9.82 788	13	9.95 875	25	0.04 125	9.86 913	11	43
18	9.82 802	14	9.95 901	26	0.04 099	9.86 902	11	42
19	9.82 816	14	9.95 926	25	0.04 074	9.86 890	12	41
20	9.82 830	14	9.95 952	26	0.04 048	9.86 879	11	**40**
21	9.82 844	14	9.95 977	25	0.04 023	9.86 867	12	39
22	9.82 858	14	9.96 002	25	0.03 998	9.86 855	12	38
23	9.82 872	14	9.96 028	26	0.03 972	9.86 844	11	37
24	9.82 885	13	9.96 053	25	0.03 947	9.86 832	12	36
25	9.82 899	14	9.96 078	25	0.03 922	9.86 821	11	35
26	9.82 913	14	9.96 104	26	0.03 896	9.86 809	12	34
27	9.82 927	14	9.96 129	25	0.03 871	9.86 798	11	33
28	9.82 941	14	9.96 155	26	0.03 845	9.86 786	12	32
29	9.82 955	14	9.96 180	25	0.03 820	9.86 775	11	31
30	9.82 968	13	9.96 205	25	0.03 795	9.86 763	12	**30**
31	9.82 982	14	9.96 231	26	0.03 769	9.86 752	11	29
32	9.82 996	14	9.96 256	25	0.03 744	9.86 740	12	28
33	9.83 010	14	9.96 281	25	0.03 719	9.86 728	12	27
34	9.83 023	13	9.96 307	26	0.03 693	9.86 717	11	26
35	9.83 037	14	9.96 332	25	0.03 668	9.86 705	12	25
36	9.83 051	14	9.96 357	25	0.03 643	9.86 694	11	24
37	9.83 065	14	9.96 383	26	0.03 617	9.86 682	12	23
38	9.83 078	13	9.96 408	25	0.03 592	9.86 670	12	22
39	9.83 092	14	9.96 433	25	0.03 567	9.86 659	11	21
40	9.83 106	14	9.96 459	26	0.03 541	9.86 647	12	**20**
41	9.83 120	14	9.96 484	25	0.03 516	9.86 635	12	19
42	9.83 133	13	9.96 510	26	0.03 490	9.86 624	11	18
43	9.83 147	14	9.96 535	25	0.03 465	9.86 612	12	17
44	9.83 161	14	9.96 560	25	0.03 440	9.86 600	12	16
45	9.83 174	13	9.96 586	26	0.03 414	9.86 589	11	15
46	9.83 188	14	9.96 611	25	0.03 389	9.86 577	12	14
47	9.83 202	14	9.96 636	25	0.03 364	9.86 565	12	13
48	9.83 215	13	9.96 662	26	0.03 338	9.86 554	11	12
49	9.83 229	14	9.96 687	25	0.03 313	9.86 542	12	11
50	9.83 242	13	9.96 712	25	0.03 288	9.86 530	12	**10**
51	9.83 256	14	9.96 738	26	0.03 262	9.86 518	12	9
52	9.83 270	14	9.96 763	25	0.03 237	9.86 507	11	8
53	9.83 283	13	9.96 788	25	0.03 212	9.86 495	12	7
54	9.83 297	14	9.96 814	26	0.03 186	9.86 483	12	6
55	9.83 310	13	9.96 839	25	0.03 161	9.86 472	11	5
56	9.83 324	14	9.96 864	25	0.03 136	9.86 460	12	4
57	9.83 338	14	9.96 890	26	0.03 110	9.86 448	12	3
58	9.83 351	13	9.96 915	25	0.03 085	9.86 436	12	2
59	9.83 365	14	9.96 940	25	0.03 060	9.86 425	11	1
60	9.83 378	13	9.96 966	26	0.03 034	9.86 413	12	**0**
′	L. Cos.	d.	L. Cot.	c.d.	L. Tan.	L. Sin.	d.	′

132° (312°) (227°) **47°**

P. P.		
#	**26**	**25**
1	0.4	0.4
2	0.9	0.8
3	1.3	1.2
4	1.7	1.7
5	2.2	2.1
6	2.6	2.5
7	3.0	2.9
8	3.5	3.3
9	3.9	3.8
10	4.3	4.2
20	8.7	8.3
30	13.0	12.5
40	17.3	16.7
50	21.7	20.8

P. P.		
#	**14**	**13**
1	0.2	0.2
2	0.5	0.4
3	0.7	0.6
4	0.9	0.9
5	1.2	1.1
6	1.4	1.3
7	1.6	1.5
8	1.9	1.7
9	2.1	2.0
10	2.3	2.2
20	4.7	4.3
30	7.0	6.5
40	9.3	8.7
50	11.7	10.8

P. P.		
#	**12**	**11**
1	0.2	0.2
2	0.4	0.4
3	0.6	0.6
4	0.8	0.7
5	1.0	0.9
6	1.2	1.1
7	1.4	1.3
8	1.6	1.5
9	1.8	1.6
10	2.0	1.8
20	4.0	3.7
30	6.0	5.5
40	8.0	7.3
50	10.0	9.2

	12	**11**	**11**
	26	**26**	**25**
0	1.1	1.2	1.
1	3.2	3.5	3.
2	5.4	5.9	5.
3	7.6	8.3	7.
4	9.8	10.6	10.
5	11.9	13.0	12.
6	14.1	15.4	14.
7	16.2	17.7	17.
8	18.4	20.1	19.
9	20.6	22.5	21.
10	22.8	24.8	23.
11	24.9	—	—
12			

43° (223°) (316°) **136°**

′	L. Sin.	d.	L. Tan.	c.d.	L. Cot.	L. Cos.	d.
0	9.83 378		9.96 966		0.03 034	9.86 413	
1	9.83 392	14	9.96 991	25	0.03 009	9.86 401	12
2	9.83 405	13	9.97 016	25	0.02 984	9.86 389	12
3	9.83 419	14	9.97 042	26	0.02 958	9.86 377	12
4	9.83 432	13	9.97 067	25	0.02 933	9.86 366	11
5	9.83 446	14	9.97 092	25	0.02 908	9.86 354	12
6	9.83 459	13	9.97 118	26	0.02 882	9.86 342	12
7	9.83 473	14	9.97 143	25	0.02 857	9.86 330	12
8	9.83 486	13	9.97 168	25	0.02 832	9.86 318	12
9	9.83 500	14	9.97 193	25	0.02 807	9.86 306	12
10	9.83 513	13	9.97 219	26	0.02 781	9.86 295	11
11	9.83 527	14	9.97 244	25	0.02 756	9.86 283	12
12	9.83 540	13	9.97 269	25	0.02 731	9.86 271	12
13	9.83 554	14	9.97 295	26	0.02 705	9.86 259	12
14	9.83 567	13	9.97 320	25	0.02 680	9.86 247	12
15	9.83 581	14	9.97 345	25	0.02 655	9.86 235	12
16	9.83 594	13	9.97 371	26	0.02 629	9.86 223	12
17	9.83 608	14	9.97 396	25	0.02 604	9.86 211	12
18	9.83 621	13	9.97 421	25	0.02 579	9.86 200	11
19	9.83 634	13	9.97 447	26	0.02 553	9.86 188	12
20	9.83 648	14	9.97 472	25	0.02 528	9.86 176	12
21	9.83 661	13	9.97 497	25	0.02 503	9.86 164	12
22	9.83 674	13	9.97 523	26	0.02 477	9.86 152	12
23	9.83 688	14	9.97 548	25	0.02 452	9.86 140	12
24	9.83 701	13	9.97 573	25	0.02 427	9.86 128	12
25	9.83 715	14	9.97 598	25	0.02 402	9.86 116	12
26	9.83 728	13	9.97 624	26	0.02 376	9.86 104	12
27	9.83 741	13	9.97 649	25	0.02 351	9.86 092	12
28	9.83 755	14	9.97 674	25	0.02 326	9.86 080	12
29	9.83 768	13	9.97 700	26	0.02 300	9.86 068	12
30	9.83 781	13	9.97 725	25	0.02 275	9.86 056	12
31	9.83 795	14	9.97 750	25	0.02 250	9.86 044	12
32	9.83 808	13	9.97 776	26	0.02 224	9.86 032	12
33	9.83 821	13	9.97 801	25	0.02 199	9.86 020	12
34	9.83 834	13	9.97 826	25	0.02 174	9.86 008	12
35	9.83 848	14	9.97 851	25	0.02 149	9.85 996	12
36	9.83 861	13	9.97 877	26	0.02 123	9.85 984	12
37	9.83 874	13	9.97 902	25	0.02 098	9.85 972	12
38	9.83 887	13	9.97 927	25	0.02 073	9.85 960	12
39	9.83 901	14	9.97 953	26	0.02 047	9.85 948	12
40	9.83 914	13	9.97 978	25	0.02 022	9.85 936	12
41	9.83 927	13	9.98 003	25	0.01 997	9.85 924	12
42	9.83 940	13	9.98 029	26	0.01 971	9.85 912	12
43	9.83 954	14	9.98 054	25	0.01 946	9.85 900	12
44	9.83 967	13	9.98 079	25	0.01 921	9.85 888	12
45	9.83 980	13	9.98 104	25	0.01 896	9.85 876	12
46	9.83 993	13	9.98 130	26	0.01 870	9.85 864	12
47	9.84 006	13	9.98 155	25	0.01 845	9.85 851	13
48	9.84 020	14	9.98 180	25	0.01 820	9.85 839	12
49	9.84 033	13	9.98 206	26	0.01 794	9.85 827	12
50	9.84 046	13	9.98 231	25	0.01 769	9.85 815	12
51	9.84 059	13	9.98 256	25	0.01 744	9.85 803	12
52	9.84 072	13	9.98 281	25	0.01 719	9.85 791	12
53	9.84 085	13	9.98 307	26	0.01 693	9.85 779	13
54	9.84 098	14	9.98 332	25	0.01 668	9.85 766	12
55	9.84 112	13	9.98 357	25	0.01 643	9.85 754	12
56	9.84 125	13	9.98 383	26	0.01 617	9.85 742	12
57	9.84 138	13	9.98 408	25	0.01 592	9.85 730	12
58	9.84 151	13	9.98 433	25	0.01 567	9.85 718	12
59	9.84 164	13	9.98 458	25	0.01 542	9.85 706	12
60	9.84 177	13	9.98 484	26	0.01 516	9.85 693	13
′	L. Cos.	d.	L. Cot.	c.d.	L. Tan.	L. Sin.	d.

′	P. P.		
60	″	**26**	**25**
59	1	0.4	0.4
58	2	0.9	0.8
57	3	1.3	1.2
56	4	1.7	1.7
55	5	2.2	2.1
54	6	2.6	2.5
53	7	3.0	2.9
52	8	3.5	3.3
51	9	3.9	3.8
50	10	4.3	4.2
49	20	8.7	8.3
48	30	13.0	12.5
47	40	17.3	16.7
46	50	21.7	20.8
45	″	**14**	**13**
44	1	0.2	0.2
43	2	0.5	0.4
42	3	0.7	0.6
41	4	0.9	0.9
40	5	1.2	1.1
39	6	1.4	1.3
38	7	1.6	1.5
37	8	1.9	1.7
36	9	2.1	2.0
35	10	2.3	2.2
34	20	4.7	4.3
33	30	7.0	6.5
32	40	9.3	8.7
31	50	11.7	10.8
30	″	**12**	**11**
29	1	0.2	0.2
28	2	0.4	0.4
27	3	0.6	0.6
26	4	0.8	0.7
25	5	1.0	0.9
24	6	1.2	1.1
23	7	1.4	1.3
22	8	1.6	1.5
21	9	1.8	1.6
20	10	2.0	1.8
19	20	4.0	3.7
18	30	6.0	5.5
17	40	8.0	7.3
16	50	10.0	9.2

′		**13**	**13**	**12**
		26	**25**	**25**
15	0	1.0	0.9	1.1
14	1	3.0	2.9	3.1
13	2	5.0	4.8	5.2
12	3	7.0	6.7	7.3
11	4	9.0	8.7	9.4
10	5	11.0	10.6	11.5
9	6	13.0	12.5	13.5
8	7	15.0	14.4	15.6
7	8	17.0	16.3	17.7
6	9	19.0	18.3	19.8
5	10	21.0	20.2	21.9
4	11	23.0	22.1	23.9
3	12	25.0	24.1	—
2	13			
1	′	P. P.		
0				

133° (313°) (226°) **46°**

44° (224°) (315°) **135°**

′	L. Sin.	d.	L. Tan.	c.d.	L. Cot.	L. Cos.	d.	′
0	9.84 177		9.98 484		0.01 516	9.85 693		**60**
1	9.84 190	13	9.98 509	25	0.01 491	9.85 681	12	59
2	9.84 203	13	9.98 534	25	0.01 466	9.85 669	12	58
3	9.84 216	13	9.98 560	26	0.01 440	9.85 657	12	57
4	9.84 229	13	9.98 585	25	0.01 415	9.85 645	12	56
5	9.84 242	13	9.98 610	25	0.01 390	9.85 632	13	55
6	9.84 255	14	9.98 635	25	0.01 365	9.85 620	12	54
7	9.84 269	13	9.98 661	26	0.01 339	9.85 608	12	53
8	9.84 282	13	9.98 686	25	0.01 314	9.85 596	12	52
9	9.84 295	13	9.98 711	25	0.01 289	9.85 583	13	51
10	9.84 308	13	9.98 737	26	0.01 263	9.85 571	12	**50**
11	9.84 321	13	9.98 762	25	0.01 238	9.85 559	12	49
12	9.84 334	13	9.98 787	25	0.01 213	9.85 547	12	48
13	9.84 347	13	9.98 812	25	0.01 188	9.85 534	13	47
14	9.84 360	13	9.98 838	26	0.01 162	9.85 522	12	46
15	9.84 373	13	9.98 863	25	0.01 137	9.85 510	12	45
16	9.84 385	12	9.98 888	25	0.01 112	9.85 497	13	44
17	9.84 398	13	9.98 913	25	0.01 087	9.85 485	12	43
18	9.84 411	13	9.98 939	26	0.01 061	9.85 473	12	42
19	9.84 424	13	9.98 964	25	0.01 036	9.85 460	13	41
20	9.84 437	13	9.98 989	25	0.01 011	9.85 448	12	**40**
21	9.84 450	13	9.99 015	26	0.00 985	9.85 436	12	39
22	9.84 463	13	9.99 040	25	0.00 960	9.85 423	13	38
23	9.84 476	13	9.99 065	25	0.00 935	9.85 411	12	37
24	9.84 489	13	9.99 090	25	0.00 910	9.85 399	12	36
25	9.84 502	13	9.99 116	26	0.00 884	9.85 386	13	35
26	9.84 515	13	9.99 141	25	0.00 859	9.85 374	12	34
27	9.84 528	13	9.99 166	25	0.00 834	9.85 361	13	33
28	9.84 540	12	9.99 191	25	0.00 809	9.85 349	12	32
29	9.84 553	13	9.99 217	26	0.00 783	9.85 337	12	31
30	9.84 566	13	9.99 242	25	0.00 758	9.85 324	13	**30**
31	9.84 579	13	9.99 267	25	0.00 733	9.85 312	12	29
32	9.84 592	13	9.99 293	26	0.00 707	9.85 299	13	28
33	9.84 605	13	9.99 318	25	0.00 682	9.85 287	12	27
34	9.84 618	13	9.99 343	25	0.00 657	9.85 274	13	26
35	9.84 630	12	9.99 368	25	0.00 632	9.85 262	12	25
36	9.84 643	13	9.99 394	26	0.00 606	9.85 250	12	24
37	9.84 656	13	9.99 419	25	0.00 581	9.85 237	13	23
38	9.84 669	13	9.99 444	25	0.00 556	9.85 225	12	22
39	9.84 682	13	9.99 469	25	0.00 531	9.85 212	13	21
40	9.84 694	12	9.99 495	26	0.00 505	9.85 200	12	**20**
41	9.84 707	13	9.99 520	25	0.00 480	9.85 187	13	19
42	9.84 720	13	9.99 545	25	0.00 455	9.85 175	12	18
43	9.84 733	13	9.99 570	25	0.00 430	9.85 162	13	17
44	9.84 745	12	9.99 596	26	0.00 404	9.85 150	12	16
45	9.84 758	13	9.99 621	25	0.00 379	9.85 137	13	15
46	9.84 771	13	9.99 646	25	0.00 354	9.85 125	12	14
47	9.84 784	13	9.99 672	26	0.00 328	9.85 112	13	13
48	9.84 796	12	9.99 697	25	0.00 303	9.85 100	12	12
49	9.84 809	13	9.99 722	25	0.00 278	9.85 087	13	11
50	9.84 822	13	9.99 747	25	0.00 253	9.85 074	13	**10**
51	9.84 835	13	9.99 773	26	0.00 227	9.85 062	12	9
52	9.84 847	12	9.99 798	25	0.00 202	9.85 049	13	8
53	9.84 860	13	9.99 823	25	0.00 177	9.85 037	12	7
54	9.84 873	13	9.99 848	25	0.00 152	9.85 024	13	6
55	9.84 885	12	9.99 874	26	0.00 126	9.85 012	12	5
56	9.84 898	13	9.99 899	25	0.00 101	9.84 999	13	4
57	9.84 911	13	9.99 924	25	0.00 076	9.84 986	13	3
58	9.84 923	12	9.99 949	25	0.00 051	9.84 974	12	2
59	9.84 936	13	9.99 975	26	0.00 025	9.84 961	13	1
60	9.84 949	13	0.00 000	25	0.00 000	9.84 949	12	**0**
′	L. Cos.	d.	L. Cot.	c.d.	L. Tan.	L. Sin.	d.	′

P. P.		
″	**26**	**25**
1	0.4	0.4
2	0.9	0.8
3	1.3	1.2
4	1.7	1.7
5	2.2	2.1
6	2.6	2.5
7	3.0	2.9
8	3.5	3.3
9	3.9	3.8
10	4.3	4.2
20	8.7	8.3
30	13.0	12.5
40	17.3	16.7
50	21.7	20.8

″	**14**	**13**	**12**
1	0.2	0.2	0.2
2	0.5	0.4	0.4
3	0.7	0.6	0.6
4	0.9	0.9	0.8
5	1.2	1.1	1.0
6	1.4	1.3	1.2
7	1.6	1.5	1.4
8	1.9	1.7	1.6
9	2.1	2.0	1.8
10	2.3	2.2	2.0
20	4.7	4.3	4.0
30	7.0	6.5	6.0
40	9.3	8.7	8.0
50	11.7	10.8	10.0

	13	**13**
	26	**25**
0	1.0	0.9
1	3.0	2.9
2	5.0	4.8
3	7.0	6.7
4	9.0	8.7
5	11.0	10.6
6	13.0	12.5
7	15.0	14.4
8	17.0	16.3
9	19.0	18.3
10	21.0	20.2
11	23.0	22.1
12	25.0	24.1
13		

	12	**12**
	26	**25**
0	1.1	1.1
1	3.2	3.1
2	5.4	5.2
3	7.6	7.3
4	9.8	9.4
5	11.9	11.5
6	14.1	13.5
7	16.2	15.6
8	18.4	17.7
9	20.6	19.8
10	22.8	21.9
11	24.9	23.9
12		

134° (314°) (225°) **45°**

NATURAL TRIGONOMETRIC FUNCTIONS

Values of the trigonometric functions of angles for each minute from 0–360°.

For degrees indicated at the top of the page use the column headings at the top. For degrees indicated at the bottom use the column indications at the bottom.

With degrees at the left of each block (top or bottom), use the minute column at the left and with degrees at the right of each block use the minute column at the right.

0° (180°) (359°) **179°**

′	Sin	Tan	Cot	Cos	′
0	.00000	.00000	———	1.0000	**60**
1	.00029	.00029	3437.7	1.0000	59
2	.00058	.00058	1718.9	1.0000	58
3	.00087	.00087	1145.9	1.0000	57
4	.00116	.00116	859.44	1.0000	56
5	.00145	.00145	687.55	1.0000	**55**
6	.00175	.00175	572.96	1.0000	54
7	.00204	.00204	491.11	1.0000	53
8	.00233	.00233	429.72	1.0000	52
9	.00262	.00262	381.97	1.0000	51
10	.00291	.00291	343.77	1.0000	**50**
11	.00320	.00320	312.52	.99999	49
12	.00349	.00349	286.48	.99999	48
13	.00378	.00378	264.44	.99999	47
14	.00407	.00407	245.55	.99999	46
15	.00436	.00436	229.18	.99999	**45**
16	.00465	.00465	214.86	.99999	44
17	.00495	.00495	202.22	.99999	43
18	.00524	.00524	190.98	.99999	42
19	.00553	.00553	180.93	.99998	41
20	.00582	.00582	171.89	.99998	**40**
21	.00611	.00611	163.70	.99998	39
22	.00640	.00640	156.26	.99998	38
23	.00669	.00669	149.47	.99998	37
24	.00698	.00698	143.24	.99998	36
25	.00727	.00727	137.51	.99997	**35**
26	.00756	.00756	132.22	.99997	34
27	.00785	.00785	127.32	.99997	33
28	.00814	.00815	122.77	.99997	32
29	.00844	.00844	118.54	.99996	31
30	.00873	.00873	114.59	.99996	**30**
31	.00902	.00902	110.89	.99996	29
32	.00931	.00931	107.43	.99996	28
33	.00960	.00960	104.17	.99995	27
34	.00989	.00989	101.11	.99995	26
35	.01018	.01018	98.218	.99995	**25**
36	.01047	.01047	95.489	.99995	24
37	.01076	.01076	92.908	.99994	23
38	.01105	.01105	90.463	.99994	22
39	.01134	.01135	88.144	.99994	21
40	.01164	.01164	85.940	.99993	**20**
41	.01193	.01193	83.844	.99993	19
42	.01222	.01222	81.847	.99993	18
43	.01251	.01251	79.943	.99992	17
44	.01280	.01280	78.126	.99992	16
45	.01309	.01309	76.390	.99991	**15**
46	.01338	.01338	74.729	.99991	14
47	.01367	.01367	73.139	.99991	13
48	.01396	.01396	71.615	.99990	12
49	.01425	.01425	70.153	.99990	11
50	.01454	.01455	68.750	.99989	**10**
51	.01483	.01484	67.402	.99989	9
52	.01513	.01513	66.105	.99989	8
53	.01542	.01542	64.858	.99988	7
54	.01571	.01571	63.657	.99988	6
55	.01600	.01600	62.499	.99987	**5**
56	.01629	.01629	61.383	.99987	4
57	.01658	.01658	60.306	.99986	3
58	.01687	.01687	59.266	.99986	2
59	.01716	.01716	58.261	.99985	1
60	.01745	.01746	57.290	.99985	**0**
′	Cos	Cot	Tan	Sin	′

90° (270°) (269°) **89°**

1° (181°) (358°) **178°**

′	Sin	Tan	Cot	Cos	′
0	.01745	.01746	57.290	.99985	**60**
1	.01774	.01775	56.351	.99984	59
2	.01803	.01804	55.442	.99984	58
3	.01832	.01833	54.561	.99983	57
4	.01862	.01862	53.709	.99983	56
5	.01891	.01891	52.882	.99982	**55**
6	.01920	.01920	52.081	.99982	54
7	.01949	.01949	51.303	.99981	53
8	.01978	.01978	50.549	.99980	52
9	.02007	.02007	49.816	.99980	51
10	.02036	.02036	49.104	.99979	**50**
11	.02065	.02066	48.412	.99979	49
12	.02094	.02095	47.740	.99978	48
13	.02123	.02124	47.085	.99977	47
14	.02152	.02153	46.449	.99977	46
15	.02181	.02182	45.829	.99976	**45**
16	.02211	.02211	45.226	.99976	44
17	.02240	.02240	44.639	.99975	43
18	.02269	.02269	44.066	.99974	42
19	.02298	.02298	43.508	.99974	41
20	.02327	.02328	42.964	.99973	**40**
21	.02356	.02357	42.433	.99972	39
22	.02385	.02386	41.916	.99972	38
23	.02414	.02415	41.411	.99971	37
24	.02443	.02444	40.917	.99970	36
25	.02472	.02473	40.436	.99969	**35**
26	.02501	.02502	39.965	.99969	34
27	.02530	.02531	39.506	.99968	33
28	.02560	.02560	39.057	.99967	32
29	.02589	.02589	38.618	.99966	31
30	.02618	.02619	38.188	.99966	**30**
31	.02647	.02648	37.769	.99965	29
32	.02676	.02677	37.358	.99964	28
33	.02705	.02706	36.956	.99963	27
34	.02734	.02735	36.563	.99963	26
35	.02763	.02764	36.178	.99962	**25**
36	.02792	.02793	35.801	.99961	24
37	.02821	.02822	35.431	.99960	23
38	.02850	.02851	35.070	.99959	22
39	.02879	.02881	34.715	.99959	21
40	.02908	.02910	34.368	.99958	**20**
41	.02938	.02939	34.027	.99957	19
42	.02967	.02968	33.694	.99956	18
43	.02996	.02997	33.366	.99955	17
44	.03025	.03026	33.045	.99954	16
45	.03054	.03055	32.730	.99953	**15**
46	.03083	.03084	32.421	.99952	14
47	.03112	.03114	32.118	.99952	13
48	.03141	.03143	31.821	.99951	12
49	.03170	.03172	31.528	.99950	11
50	.03199	.03201	31.242	.99949	**10**
51	.03228	.03230	30.960	.99948	9
52	.03257	.03259	30.683	.99947	8
53	.03286	.03288	30.412	.99946	7
54	.03316	.03317	30.145	.99945	6
55	.03345	.03346	29.882	.99944	**5**
56	.03374	.03376	29.624	.99943	4
57	.03403	.03405	29.371	.99942	3
58	.03432	.03434	29.122	.99941	2
59	.03461	.03463	28.877	.99940	1
60	.03490	.03492	28.636	.99939	**0**
′	Cos	Cot	Tan	Sin	′

91° (271°) (268°) **88**

2° (182°) (357°) **177°**

′	Sin	Tan	Cot	Cos	′
0	.03490	.03492	28.636	.99939	60
1	.03519	.03521	28.399	.99938	59
2	.03548	.03550	28.166	.99937	58
3	.03577	.03579	27.937	.99936	57
4	.03606	.03609	27.712	.99935	56
5	.03635	.03638	27.490	.99934	55
6	.03664	.03667	27.271	.99933	54
7	.03693	.03696	27.057	.99932	53
8	.03723	.03725	26.845	.99931	52
9	.03752	.03754	26.637	.99930	51
10	.03781	.03783	26.432	.99929	50
11	.03810	.03812	26.230	.99927	49
12	.03839	.03842	26.031	.99926	48
13	.03868	.03871	25.835	.99925	47
14	.03897	.03900	25.642	.99924	46
15	.03926	.03929	25.452	.99923	45
16	.03955	.03958	25.264	.99922	44
17	.03984	.03987	25.080	.99921	43
18	.04013	.04016	24.898	.99919	42
19	.04042	.04046	24.719	.99918	41
20	.04071	.04075	24.542	.99917	40
21	.04100	.04104	24.368	.99916	39
22	.04129	.04133	24.196	.99915	38
23	.04159	.04162	24.026	.99913	37
24	.04188	.04191	23.859	.99912	36
25	.04217	.04220	23.695	.99911	35
26	.04246	.04250	23.532	.99910	34
27	.04275	.04279	23.372	.99909	33
28	.04304	.04308	23.214	.99907	32
29	.04333	.04337	23.058	.99906	31
30	.04362	.04366	22.904	.99905	30
31	.04391	.04395	22.752	.99904	29
32	.04420	.04424	22.602	.99902	28
33	.04449	.04454	22.454	.99901	27
34	.04478	.04483	22.308	.99900	26
35	.04507	.04512	22.164	.99898	25
36	.04536	.04541	22.022	.99897	24
37	.04565	.04570	21.881	.99896	23
38	.04594	.04599	21.743	.99894	22
39	.04623	.04628	21.606	.99893	21
40	.04653	.04658	21.470	.99892	20
41	.04682	.04687	21.337	.99890	19
42	.04711	.04716	21.205	.99889	18
43	.04740	.04745	21.075	.99888	17
44	.04769	.04774	20.946	.99886	16
45	.04798	.04803	20.819	.99885	15
46	.04827	.04833	20.693	.99883	14
47	.04856	.04862	20.569	.99882	13
48	.04885	.04891	20.446	.99881	12
49	.04914	.04920	20.325	.99879	11
50	.04943	.04949	20.206	.99878	10
51	.04972	.04978	20.087	.99876	9
52	.05001	.05007	19.970	.99875	8
53	.05030	.05037	19.855	.99873	7
54	.05059	.05066	19.740	.99872	6
55	.05088	.05095	19.627	.99870	5
56	.05117	.05124	19.516	.99869	4
57	.05146	.05153	19.405	.99867	3
58	.05175	.05182	19.296	.99866	2
59	.05205	.05212	19.188	.99864	1
60	.05234	.05241	19.081	.99863	0
′	Cos	Cot	Tan	Sin	′

92° (272°) (267°) **87°**

3° (183°) (356°) **176°**

′	Sin	Tan	Cot	Cos	′
0	.05234	.05241	19.081	.99863	60
1	.05263	.05270	18.976	.99861	59
2	.05292	.05299	18.871	.99860	58
3	.05321	.05328	18.768	.99858	57
4	.05350	.05357	18.666	.99857	56
5	.05379	.05387	18.564	.99855	55
6	.05408	.05416	18.464	.99854	54
7	.05437	.05445	18.366	.99852	53
8	.05466	.05474	18.268	.99851	52
9	.05495	.05503	18.171	.99849	51
10	.05524	.05533	18.075	.99847	50
11	.05553	.05562	17.980	.99846	49
12	.05582	.05591	17.886	.99844	48
13	.05611	.05620	17.793	.99842	47
14	.05640	.05649	17.702	.99841	46
15	.05669	.05678	17.611	.99839	45
16	.05698	.05708	17.521	.99838	44
17	.05727	.05737	17.431	.99836	43
18	.05756	.05766	17.343	.99834	42
19	.05785	.05795	17.256	.99833	41
20	.05814	.05824	17.169	.99831	40
21	.05844	.05854	17.084	.99829	39
22	.05873	.05883	16.999	.99827	38
23	.05902	.05912	16.915	.99826	37
24	.05931	.05941	16.832	.99824	36
25	.05960	.05970	16.750	.99822	35
26	.05989	.05999	16.668	.99821	34
27	.06018	.06029	16.587	.99819	33
28	.06047	.06058	16.507	.99817	32
29	.06076	.06087	16.428	.99815	31
30	.06105	.06116	16.350	.99813	30
31	.06134	.06145	16.272	.99812	29
32	.06163	.06175	16.195	.99810	28
33	.06192	.06204	16.119	.99808	27
34	.06221	.06233	16.043	.99806	26
35	.06250	.06262	15.969	.99804	25
36	.06279	.06291	15.895	.99803	24
37	.06308	.06321	15.821	.99801	23
38	.06337	.06350	15.748	.99799	22
39	.06366	.06379	15.676	.99797	21
40	.06395	.06408	15.605	.99795	20
41	.06424	.06438	15.534	.99793	19
42	.06453	.06467	15.464	.99792	18
43	.06482	.06496	15.394	.99790	17
44	.06511	.06525	15.325	.99788	16
45	.06540	.06554	15.257	.99786	15
46	.06569	.06584	15.189	.99784	14
47	.06598	.06613	15.122	.99782	13
48	.06627	.06642	15.056	.99780	12
49	.06656	.06671	14.990	.99778	11
50	.06685	.06700	14.924	.99776	10
51	.06714	.06730	14.860	.99774	9
52	.06743	.06759	14.795	.99772	8
53	.06773	.06788	14.732	.99770	7
54	.06802	.06817	14.669	.99768	6
55	.06831	.06847	14.606	.99766	5
56	.06860	.06876	14.544	.99764	4
57	.06889	.06905	14.482	.99762	3
58	.06918	.06934	14.421	.99760	2
59	.06947	.06963	14.361	.99758	1
60	.06976	.06993	14.301	.99756	0
′	Cos	Cot	Tan	Sin	′

93° (273°) (266°) **86°**

4° (184°) (355°) 175°

′	Sin	Tan	Cot	Cos	′
0	.06976	.06993	14.301	.99756	60
1	.07005	.07022	14.241	.99754	59
2	.07034	.07051	14.182	.99752	58
3	.07063	.07080	14.124	.99750	57
4	.07092	.07110	14.065	.99748	56
5	.07121	.07139	14.008	.99746	55
6	.07150	.07168	13.951	.99744	54
7	.07179	.07197	13.894	.99742	53
8	.07208	.07227	13.838	.99740	52
9	.07237	.07256	13.782	.99738	51
10	.07266	.07285	13.727	.99736	50
11	.07295	.07314	13.672	.99734	49
12	.07324	.07344	13.617	.99731	48
13	.07353	.07373	13.563	.99729	47
14	.07382	.07402	13.510	.99727	46
15	.07411	.07431	13.457	.99725	45
16	.07440	.07461	13.404	.99723	44
17	.07469	.07490	13.352	.99721	43
18	.07498	.07519	13.300	.99719	42
19	.07527	.07548	13.248	.99716	41
20	.07556	.07578	13.197	.99714	40
21	.07585	.07607	13.146	.99712	39
22	.07614	.07636	13.096	.99710	38
23	.07643	.07665	13.046	.99708	37
24	.07672	.07695	12.996	.99705	36
25	.07701	.07724	12.947	.99703	35
26	.07730	.07753	12.898	.99701	34
27	.07759	.07782	12.850	.99699	33
28	.07788	.07812	12.801	.99696	32
29	.07817	.07841	12.754	.99694	31
30	.07846	.07870	12.706	.99692	30
31	.07875	.07899	12.659	.99689	29
32	.07904	.07929	12.612	.99687	28
33	.07933	.07958	12.566	.99685	27
34	.07962	.07987	12.520	.99683	26
35	.07991	.08017	12.474	.99680	25
36	.08020	.08046	12.429	.99678	24
37	.08049	.08075	12.384	.99676	23
38	.08078	.08104	12.339	.99673	22
39	.08107	.08134	12.295	.99671	21
40	.08136	.08163	12.251	.99668	20
41	.08165	.08192	12.207	.99666	19
42	.08194	.08221	12.163	.99664	18
43	.08223	.08251	12.120	.99661	17
44	.08252	.08280	12.077	.99659	16
45	.08281	.08309	12.035	.99657	15
46	.08310	.08339	11.992	.99654	14
47	.08339	.08368	11.950	.99652	13
48	.08368	.08397	11.909	.99649	12
49	.08397	.08427	11.867	.99647	11
50	.08426	.08456	11.826	.99644	10
51	.08455	.08485	11.785	.99642	9
52	.08484	.08514	11.745	.99639	8
53	.08513	.08544	11.705	.99637	7
54	.08542	.08573	11.664	.99635	6
55	.08571	.08602	11.625	.99632	5
56	.08600	.08632	11.585	.99630	4
57	.08629	.08661	11.546	.99627	3
58	.08658	.08690	11.507	.99625	2
59	.08687	.08720	11.468	.99622	1
60	.08716	.08749	11.430	.99619	0
′	Cos	Cot	Tan	Sin	′

94° (274°) (265°) 85°

5° (185°) (354°) 174°

′	Sin	Tan	Cot	Cos	′
0	.08716	.08749	11.430	.99619	60
1	.08745	.08778	11.392	.99617	59
2	.08774	.08807	11.354	.99614	58
3	.08803	.08837	11.316	.99612	57
4	.08831	.08866	11.279	.99609	56
5	.08860	.08895	11.242	.99607	55
6	.08889	.08925	11.205	.99604	54
7	.08918	.08954	11.168	.99602	53
8	.08947	.08983	11.132	.99599	52
9	.08976	.09013	11.095	.99596	51
10	.09005	.09042	11.059	.99594	50
11	.09034	.09071	11.024	.99591	49
12	.09063	.09101	10.988	.99588	48
13	.09092	.09130	10.953	.99586	47
14	.09121	.09159	10.918	.99583	46
15	.09150	.09189	10.883	.99580	45
16	.09179	.09218	10.848	.99578	44
17	.09208	.09247	10.814	.99575	43
18	.09237	.09277	10.780	.99572	42
19	.09266	.09306	10.746	.99570	41
20	.09295	.09335	10.712	.99567	40
21	.09324	.09365	10.678	.99564	39
22	.09353	.09394	10.645	.99562	38
23	.09382	.09423	10.612	.99559	37
24	.09411	.09453	10.579	.99556	36
25	.09440	.09482	10.546	.99553	35
26	.09469	.09511	10.514	.99551	34
27	.09498	.09541	10.481	.99548	33
28	.09527	.09570	10.449	.99545	32
29	.09556	.09600	10.417	.99542	31
30	.09585	.09629	10.385	.99540	30
31	.09614	.09658	10.354	.99537	29
32	.09642	.09688	10.322	.99534	28
33	.09671	.09717	10.291	.99531	27
34	.09700	.09746	10.260	.99528	26
35	.09729	.09776	10.229	.99526	25
36	.09758	.09805	10.199	.99523	24
37	.09787	.09834	10.168	.99520	23
38	.09816	.09864	10.138	.99517	22
39	.09845	.09893	10.108	.99514	21
40	.09874	.09923	10.078	.99511	20
41	.09903	.09952	10.048	.99508	19
42	.09932	.09981	10.019	.99506	18
43	.09961	.10011	9.9893	.99503	17
44	.09990	.10040	9.9601	.99500	16
45	.10019	.10069	9.9310	.99497	15
46	.10048	.10099	9.9021	.99494	14
47	.10077	.10128	9.8734	.99491	13
48	.10106	.10158	9.8448	.99488	12
49	.10135	.10187	9.8164	.99485	11
50	.10164	.10216	9.7882	.99482	10
51	.10192	.10246	9.7601	.99479	9
52	.10221	.10275	9.7322	.99476	8
53	.10250	.10305	9.7044	.99473	7
54	.10279	.10334	9.6768	.99470	6
55	.10308	.10363	9.6493	.99467	5
56	.10337	.10393	9.6220	.99464	4
57	.10366	.10422	9.5949	.99461	3
58	.10395	.10452	9.5679	.99458	2
59	.10424	.10481	9.5411	.99455	1
60	.10453	.10510	9.5144	.99452	0
′	Cos	Cot	Tan	Sin	′

95° (275°) (264°) 84°

6° (186°) (353°) **173°**

′	Sin	Tan	Cot	Cos	′
0	.10453	.10510	9.5144	.99452	**60**
1	.10482	.10540	9.4878	.99449	59
2	.10511	.10569	9.4614	.99446	58
3	.10540	.10599	9.4352	.99443	57
4	.10569	.10628	9.4090	.99440	56
5	.10597	.10657	9.3831	.99437	**55**
6	.10626	.10687	9.3572	.99434	54
7	.10655	.10716	9.3315	.99431	53
8	.10684	.10746	9.3060	.99428	52
9	.10713	.10775	9.2806	.99424	51
10	.10742	.10805	9.2553	.99421	**50**
11	.10771	.10834	9.2302	.99418	49
12	.10800	.10863	9.2052	.99415	48
13	.10829	.10893	9.1803	.99412	47
14	.10858	.10922	9.1555	.99409	46
15	.10887	.10952	9.1309	.99406	**45**
16	.10916	.10981	9.1065	.99402	44
17	.10945	.11011	9.0821	.99399	43
18	.10973	.11040	9.0579	.99396	42
19	.11002	.11070	9.0338	.99393	41
20	.11031	.11099	9.0098	.99390	**40**
21	.11060	.11128	8.9860	.99386	39
22	.11089	.11158	8.9623	.99383	38
23	.11118	.11187	8.9387	.99380	37
24	.11147	.11217	8.9152	.99377	36
25	.11176	.11246	8.8919	.99374	**35**
26	.11205	.11276	8.8686	.99370	34
27	.11234	.11305	8.8455	.99367	33
28	.11263	.11335	8.8225	.99364	32
29	.11291	.11364	8.7996	.99360	31
30	.11320	.11394	8.7769	.99357	**30**
31	.11349	.11423	8.7542	.99354	29
32	.11378	.11452	8.7317	.99351	28
33	.11407	.11482	8.7093	.99347	27
34	.11436	.11511	8.6870	.99344	26
35	.11465	.11541	8.6648	.99341	**25**
36	.11494	.11570	8.6427	.99337	24
37	.11523	.11600	8.6208	.99334	23
38	.11552	.11629	8.5989	.99331	22
39	.11580	.11659	8.5772	.99327	21
40	.11609	.11688	8.5555	.99324	**20**
41	.11638	.11718	8.5340	.99320	19
42	.11667	.11747	8.5126	.99317	18
43	.11696	.11777	8.4913	.99314	17
44	.11725	.11806	8.4701	.99310	16
45	.11754	.11836	8.4490	.99307	**15**
46	.11783	.11865	8.4280	.99303	14
47	.11812	.11895	8.4071	.99300	13
48	.11840	.11924	8.3863	.99297	12
49	.11869	.11954	8.3656	.99293	11
50	.11898	.11983	8.3450	.99290	**10**
51	.11927	.12013	8.3245	.99286	9
52	.11956	.12042	8.3041	.99283	8
53	.11985	.12072	8.2838	.99279	7
54	.12014	.12101	8.2636	.99276	6
55	.12043	.12131	8.2434	.99272	**5**
56	.12071	.12160	8.2234	.99269	4
57	.12100	.12190	8.2035	.99265	3
58	.12129	.12219	8.1837	.99262	2
59	.12158	.12249	8.1640	.99258	1
60	.12187	.12278	8.1443	.99255	**0**
′	Cos	Cot	Tan	Sin	′

7° (187°) (352°) **172°**

′	Sin	Tan	Cot	Cos	′
0	.12187	.12278	8.1443	.99255	**60**
1	.12216	.12308	8.1248	.99251	59
2	.12245	.12338	8.1054	.99248	58
3	.12274	.12367	8.0860	.99244	57
4	.12302	.12397	8.0667	.99240	56
5	.12331	.12426	8.0476	.99237	**55**
6	.12360	.12456	8.0285	.99233	54
7	.12389	.12485	8.0095	.99230	53
8	.12418	.12515	7.9906	.99226	52
9	.12447	.12544	7.9718	.99222	51
10	.12476	.12574	7.9530	.99219	**50**
11	.12504	.12603	7.9344	.99215	49
12	.12533	.12633	7.9158	.99211	48
13	.12562	.12662	7.8973	.99208	47
14	.12591	.12692	7.8789	.99204	46
15	.12620	.12722	7.8606	.99200	**45**
16	.12649	.12751	7.8424	.99197	44
17	.12678	.12781	7.8243	.99193	43
18	.12706	.12810	7.8062	.99189	42
19	.12735	.12840	7.7882	.99186	41
20	.12764	.12869	7.7704	.99182	**40**
21	.12793	.12899	7.7525	.99178	39
22	.12822	.12929	7.7348	.99175	38
23	.12851	.12958	7.7171	.99171	37
24	.12880	.12988	7.6996	.99167	36
25	.12908	.13017	7.6821	.99163	**35**
26	.12937	.13047	7.6647	.99160	34
27	.12966	.13076	7.6473	.99156	33
28	.12995	.13106	7.6301	.99152	32
29	.13024	.13136	7.6129	.99148	31
30	.13053	.13165	7.5958	.99144	**30**
31	.13081	.13195	7.5787	.99141	29
32	.13110	.13224	7.5618	.99137	28
33	.13139	.13254	7.5449	.99133	27
34	.13168	.13284	7.5281	.99129	26
35	.13197	.13313	7.5113	.99125	**25**
36	.13226	.13343	7.4947	.99122	24
37	.13254	.13372	7.4781	.99118	23
38	.13283	.13402	7.4615	.99114	22
39	.13312	.13432	7.4451	.99110	21
40	.13341	.13461	7.4287	.99106	**20**
41	.13370	.13491	7.4124	.99102	19
42	.13399	.13521	7.3962	.99098	18
43	.13427	.13550	7.3800	.99094	17
44	.13456	.13580	7.3639	.99091	16
45	.13485	.13609	7.3479	.99087	**15**
46	.13514	.13639	7.3319	.99083	14
47	.13543	.13669	7.3160	.99079	13
48	.13572	.13698	7.3002	.99075	12
49	.13600	.13728	7.2844	.99071	11
50	.13629	.13758	7.2687	.99067	**10**
51	.13658	.13787	7.2531	.99063	9
52	.13687	.13817	7.2375	.99059	8
53	.13716	.13846	7.2220	.99055	7
54	.13744	.13876	7.2066	.99051	6
55	.13773	.13906	7.1912	.99047	5
56	.13802	.13935	7.1759	.99043	4
57	.13831	.13965	7.1607	.99039	3
58	.13860	.13995	7.1455	.99035	2
59	.13889	.14024	7.1304	.99031	1
60	.13917	.14054	7.1154	.99027	**0**
′	Cos	Cot	Tan	Sin	′

96° (276°) (263°) **83°**

97° (277°) (262°) **82°**

8° (188°) (351°) **171°**

′	Sin	Tan	Cot	Cos	′
0	.13917	.14054	7.1154	.99027	**60**
1	.13946	.14084	7.1004	.99023	59
2	.13975	.14113	7.0855	.99019	58
3	.14004	.14143	7.0706	.99015	57
4	.14033	.14173	7.0558	.99011	56
5	.14061	.14202	7.0410	.99006	**55**
6	.14090	.14232	7.0264	.99002	54
7	.14119	.14262	7.0117	.98998	53
8	.14148	.14291	6.9972	.98994	52
9	.14177	.14321	6.9827	.98990	51
10	.14205	.14351	6.9682	.98986	**50**
11	.14234	.14381	6.9538	.98982	49
12	.14263	.14410	6.9395	.98978	48
13	.14292	.14440	6.9252	.98973	47
14	.14320	.14470	6.9110	.98969	46
15	.14349	.14499	6.8969	.98965	**45**
16	.14378	.14529	6.8828	.98961	44
17	.14407	.14559	6.8687	.98957	43
18	.14436	.14588	6.8548	.98953	42
19	.14464	.14618	6.8408	.98948	41
20	.14493	.14648	6.8269	.98944	**40**
21	.14522	.14678	6.8131	.98940	39
22	.14551	.14707	6.7994	.98936	38
23	.14580	.14737	6.7856	.98931	37
24	.14608	.14767	6.7720	.98927	36
25	.14637	.14796	6.7584	.98923	**35**
26	.14666	.14826	6.7448	.98919	34
27	.14695	.14856	6.7313	.98914	33
28	.14723	.14886	6.7179	.98910	32
29	.14752	.14915	6.7045	.98906	31
30	.14781	.14945	6.6912	.98902	**30**
31	.14810	.14975	6.6779	.98897	29
32	.14838	.15005	6.6646	.98893	28
33	.14867	.15034	6.6514	.98889	27
34	.14896	.15064	6.6383	.98884	26
35	.14925	.15094	6.6252	.98880	**25**
36	.14954	.15124	6.6122	.98876	24
37	.14982	.15153	6.5992	.98871	23
38	.15011	.15183	6.5863	.98867	22
39	.15040	.15213	6.5734	.98863	21
40	.15069	.15243	6.5606	.98858	**20**
41	.15097	.15272	6.5478	.98854	19
42	.15126	.15302	6.5350	.98849	18
43	.15155	.15332	6.5223	.98845	17
44	.15184	.15362	6.5097	.98841	16
45	.15212	.15391	6.4971	.98836	**15**
46	.15241	.15421	6.4846	.98832	14
47	.15270	.15451	6.4721	.98827	13
48	.15299	.15481	6.4596	.98823	12
49	.15327	.15511	6.4472	.98818	11
50	.15356	.15540	6.4348	.98814	**10**
51	.15385	.15570	6.4225	.98809	9
52	.15414	.15600	6.4103	.98805	8
53	.15442	.15630	6.3980	.98800	7
54	.15471	.15660	6.3859	.98796	6
55	.15500	.15689	6.3737	.98791	**5**
56	.15529	.15719	6.3617	.98787	4
57	.15557	.15749	6.3496	.98782	3
58	.15586	.15779	6.3376	.98778	2
59	.15615	.15809	6.3257	.98773	1
60	.15643	.15838	6.3138	.98769	**0**
′	Cos	Cot	Tan	Sin	′

98° (278°) (261°) **81°**

9° (189°) (350°) **170°**

′	Sin	Tan	Cot	Cos	′
0	.15643	.15838	6.3138	.98769	**60**
1	.15672	.15868	6.3019	.98764	59
2	.15701	.15898	6.2901	.98760	58
3	.15730	.15928	6.2783	.98755	57
4	.15758	.15958	6.2666	.98751	56
5	.15787	.15988	6.2549	.98746	**55**
6	.15816	.16017	6.2432	.98741	54
7	.15845	.16047	6.2316	.98737	53
8	.15873	.16077	6.2200	.98732	52
9	.15902	.16107	6.2085	.98728	51
10	.15931	.16137	6.1970	.98723	**50**
11	.15959	.16167	6.1856	.98718	49
12	.15988	.16196	6.1742	.98714	48
13	.16017	.16226	6.1628	.98709	47
14	.16046	.16256	6.1515	.98704	46
15	.16074	.16286	6.1402	.98700	**45**
16	.16103	.16316	6.1290	.98695	44
17	.16132	.16346	6.1178	.98690	43
18	.16160	.16376	6.1066	.98686	42
19	.16189	.16405	6.0955	.98681	41
20	.16218	.16435	6.0844	.98676	**40**
21	.16246	.16465	6.0734	.98671	39
22	.16275	.16495	6.0624	.98667	38
23	.16304	.16525	6.0514	.98662	37
24	.16333	.16555	6.0405	.98657	36
25	.16361	.16585	6.0296	.98652	**35**
26	.16390	.16615	6.0188	.98648	34
27	.16419	.16645	6.0080	.98643	33
28	.16447	.16674	5.9972	.98638	32
29	.16476	.16704	5.9865	.98633	31
30	.16505	.16734	5.9758	.98629	**30**
31	.16533	.16764	5.9651	.98624	29
32	.16562	.16794	5.9545	.98619	28
33	.16591	.16824	5.9439	.98614	27
34	.16620	.16854	5.9333	.98609	26
35	.16648	.16884	5.9228	.98604	**25**
36	.16677	.16914	5.9124	.98600	24
37	.16706	.16944	5.9019	.98595	23
38	.16734	.16974	5.8915	.98590	22
39	.16763	.17004	5.8811	.98585	21
40	.16792	.17033	5.8708	.98580	**20**
41	.16820	.17063	5.8605	.98575	19
42	.16849	.17093	5.8502	.98570	18
43	.16878	.17123	5.8400	.98565	17
44	.16906	.17153	5.8298	.98561	16
45	.16935	.17183	5.8197	.98556	**15**
46	.16964	.17213	5.8095	.98551	14
47	.16992	.17243	5.7994	.98546	13
48	.17021	.17273	5.7894	.98541	12
49	.17050	.17303	5.7794	.98536	11
50	.17078	.17333	5.7694	.98531	**10**
51	.17107	.17363	5.7594	.98526	9
52	.17136	.17393	5.7495	.98521	8
53	.17164	.17423	5.7396	.98516	7
54	.17193	.17453	5.7297	.98511	6
55	.17222	.17483	5.7199	.98506	**5**
56	.17250	.17513	5.7101	.98501	4
57	.17279	.17543	5.7004	.98496	3
58	.17308	.17573	5.6906	.98491	2
59	.17336	.17603	5.6809	.98486	1
60	.17365	.17633	5.6713	.98481	**0**
′	Cos	Cot	Tan	Sin	′

99° (279°) (260°) **80**

10° (190°) (349°) 169°

′	Sin	Tan	Cot	Cos	′
0	.17365	.17633	5.6713	.98481	60
1	.17393	.17663	5.6617	.98476	59
2	.17422	.17693	5.6521	.98471	58
3	.17451	.17723	5.6425	.98466	57
4	.17479	.17753	5.6329	.98461	56
5	.17508	.17783	5.6234	.98455	55
6	.17537	.17813	5.6140	.98450	54
7	.17565	.17843	5.6045	.98445	53
8	.17594	.17873	5.5951	.98440	52
9	.17623	.17903	5.5857	.98435	51
10	.17651	.17933	5.5764	.98430	50
11	.17680	.17963	5.5671	.98425	49
12	.17708	.17993	5.5578	.98420	48
13	.17737	.18023	5.5485	.98414	47
14	.17766	.18053	5.5393	.98409	46
15	.17794	.18083	5.5301	.98404	45
16	.17823	.18113	5.5209	.98399	44
17	.17852	.18143	5.5118	.98394	43
18	.17880	.18173	5.5026	.98389	42
19	.17909	.18203	5.4936	.98383	41
20	.17937	.18233	5.4845	.98378	40
21	.17966	.18263	5.4755	.98373	39
22	.17995	.18293	5.4665	.98368	38
23	.18023	.18323	5.4575	.98362	37
24	.18052	.18353	5.4486	.98357	36
25	.18081	.18384	5.4397	.98352	35
26	.18109	.18414	5.4308	.98347	34
27	.18138	.18444	5.4219	.98341	33
28	.18166	.18474	5.4131	.98336	32
29	.18195	.18504	5.4043	.98331	31
30	.18224	.18534	5.3955	.98325	30
31	.18252	.18564	5.3868	.98320	29
32	.18281	.18594	5.3781	.98315	28
33	.18309	.18624	5.3694	.98310	27
34	.18338	.18654	5.3607	.98304	26
35	.18367	.18684	5.3521	.98299	25
36	.18395	.18714	5.3435	.98294	24
37	.18424	.18745	5.3349	.98288	23
38	.18452	.18775	5.3263	.98283	22
39	.18481	.18805	5.3178	.98277	21
40	.18509	.18835	5.3093	.98272	20
41	.18538	.18865	5.3008	.98267	19
42	.18567	.18895	5.2924	.98261	18
43	.18595	.18925	5.2839	.98256	17
44	.18624	.18955	5.2755	.98250	16
45	.18652	.18986	5.2672	.98245	15
46	.18681	.19016	5.2588	.98240	14
47	.18710	.19046	5.2505	.98234	13
48	.18738	.19076	5.2422	.98229	12
49	.18767	.19106	5.2339	.98223	11
50	.18795	.19136	5.2257	.98218	10
51	.18824	.19166	5.2174	.98212	9
52	.18852	.19197	5.2092	.98207	8
53	.18881	.19227	5.2011	.98201	7
54	.18910	.19257	5.1929	.98196	6
55	.18938	.19287	5.1848	.98190	5
56	.18967	.19317	5.1767	.98185	4
57	.18995	.19347	5.1686	.98179	3
58	.19024	.19378	5.1606	.98174	2
59	.19052	.19408	5.1526	.98168	1
60	.19081	.19438	5.1446	.98163	0
′	Cos	Cot	Tan	Sin	′

100°(280°) (259°)79°

11° (191°) (348°) 168°

′	Sin	Tan	Cot	Cos	′
0	.19081	.19438	5.1446	.98163	60
1	.19109	.19468	5.1366	.98157	59
2	.19138	.19498	5.1286	.98152	58
3	.19167	.19529	5.1207	.98146	57
4	.19195	.19559	5.1128	.98140	56
5	.19224	.19589	5.1049	.98135	55
6	.19252	.19619	5.0970	.98129	54
7	.19281	.19649	5.0892	.98124	53
8	.19309	.19680	5.0814	.98118	52
9	.19338	.19710	5.0736	.98112	51
10	.19366	.19740	5.0658	.98107	50
11	.19395	.19770	5.0581	.98101	49
12	.19423	.19801	5.0504	.98096	48
13	.19452	.19831	5.0427	.98090	47
14	.19481	.19861	5.0350	.98084	46
15	.19509	.19891	5.0273	.98079	45
16	.19538	.19921	5.0197	.98073	44
17	.19566	.19952	5.0121	.98067	43
18	.19595	.19982	5.0045	.98061	42
19	.19623	.20012	4.9969	.98056	41
20	.19652	.20042	4.9894	.98050	40
21	.19680	.20073	4.9819	.98044	39
22	.19709	.20103	4.9744	.98039	38
23	.19737	.20133	4.9669	.98033	37
24	.19766	.20164	4.9594	.98027	36
25	.19794	.20194	4.9520	.98021	35
26	.19823	.20224	4.9446	.98016	34
27	.19851	.20254	4.9372	.98010	33
28	.19880	.20285	4.9298	.98004	32
29	.19908	.20315	4.9225	.97998	31
30	.19937	.20345	4.9152	.97992	30
31	.19965	.20376	4.9078	.97987	29
32	.19994	.20406	4.9006	.97981	28
33	.20022	.20436	4.8933	.97975	27
34	.20051	.20466	4.8860	.97969	26
35	.20079	.20497	4.8788	.97963	25
36	.20108	.20527	4.8716	.97958	24
37	.20136	.20557	4.8644	.97952	23
38	.20165	.20588	4.8573	.97946	22
39	.20193	.20618	4.8501	.97940	21
40	.20222	.20648	4.8430	.97934	20
41	.20250	.20679	4.8359	.97928	19
42	.20279	.20709	4.8288	.97922	18
43	.20307	.20739	4.8218	.97916	17
44	.20336	.20770	4.8147	.97910	16
45	.20364	.20800	4.8077	.97905	15
46	.20393	.20830	4.8007	.97899	14
47	.20421	.20861	4.7937	.97893	13
48	.20450	.20891	4.7867	.97887	12
49	.20478	.20921	4.7798	.97881	11
50	.20507	.20952	4.7729	.97875	10
51	.20535	.20982	4.7659	.97869	9
52	.20563	.21013	4.7591	.97863	8
53	.20592	.21043	4.7522	.97857	7
54	.20620	.21073	4.7453	.97851	6
55	.20649	.21104	4.7385	.97845	5
56	.20677	.21134	4.7317	.97839	4
57	.20706	.21164	4.7249	.97833	3
58	.20734	.21195	4.7181	.97827	2
59	.20763	.21225	4.7114	.97821	1
60	.20791	.21256	4.7046	.97815	0
′	Cos	Cot	Tan	Sin	′

101°(281°) (258°)78°

12° (192°) (347°) **167°**

′	Sin	Tan	Cot	Cos	′
0	.20791	.21256	4.7046	.97815	**60**
1	.20820	.21286	4.6979	.97809	59
2	.20848	.21316	4.6912	.97803	58
3	.20877	.21347	4.6845	.97797	57
4	.20905	.21377	4.6779	.97791	56
5	.20933	.21408	4.6712	.97784	**55**
6	.20962	.21438	4.6646	.97778	54
7	.20990	.21469	4.6580	.97772	53
8	.21019	.21499	4.6514	.97766	52
9	.21047	.21529	4.6448	.97760	51
10	.21076	.21560	4.6382	.97754	**50**
11	.21104	.21590	4.6317	.97748	49
12	.21132	.21621	4.6252	.97742	48
13	.21161	.21651	4.6187	.97735	47
14	.21189	.21682	4.6122	.97729	46
15	.21218	.21712	4.6057	.97723	**45**
16	.21246	.21743	4.5993	.97717	44
17	.21275	.21773	4.5928	.97711	43
18	.21303	.21804	4.5864	.97705	42
19	.21331	.21834	4.5800	.97698	41
20	.21360	.21864	4.5736	.97692	**40**
21	.21388	.21895	4.5673	.97686	39
22	.21417	.21925	4.5609	.97680	38
23	.21445	.21956	4.5546	.97673	37
24	.21474	.21986	4.5483	.97667	36
25	.21502	.22017	4.5420	.97661	**35**
26	.21530	.22047	4.5357	.97655	34
27	.21559	.22078	4.5294	.97648	33
28	.21587	.22108	4.5232	.97642	32
29	.21616	.22139	4.5169	.97636	31
30	.21644	.22169	4.5107	.97630	**30**
31	.21672	.22200	4.5045	.97623	29
32	.21701	.22231	4.4983	.97617	28
33	.21729	.22261	4.4922	.97611	27
34	.21758	.22292	4.4860	.97604	26
35	.21786	.22322	4.4799	.97598	**25**
36	.21814	.22353	4.4737	.97592	24
37	.21843	.22383	4.4676	.97585	23
38	.21871	.22414	4.4615	.97579	22
39	.21899	.22444	4.4555	.97573	21
40	.21928	.22475	4.4494	.97566	**20**
41	.21956	.22505	4.4434	.97560	19
42	.21985	.22536	4.4373	.97553	18
43	.22013	.22567	4.4313	.97547	17
44	.22041	.22597	4.4253	.97541	16
45	.22070	.22628	4.4194	.97534	**15**
46	.22098	.22658	4.4134	.97528	14
47	.22126	.22689	4.4075	.97521	13
48	.22155	.22719	4.4015	.97515	12
49	.22183	.22750	4.3956	.97508	11
50	.22212	.22781	4.3897	.97502	**10**
51	.22240	.22811	4.3838	.97496	9
52	.22268	.22842	4.3779	.97489	8
53	.22297	.22872	4.3721	.97483	7
54	.22325	.22903	4.3662	.97476	6
55	.22353	.22934	4.3604	.97470	**5**
56	.22382	.22964	4.3546	.97463	4
57	.22410	.22995	4.3488	.97457	3
58	.22438	.23026	4.3430	.97450	2
59	.22467	.23056	4.3372	.97444	1
60	.22495	.23087	4.3315	.97437	**0**
′	Cos	Cot	Tan	Sin	′

102° (282°) (257°) **77°**

13° (193°) (346°) **166°**

′	Sin	Tan	Cot	Cos	′
0	.22495	.23087	4.3315	.97437	**60**
1	.22523	.23117	4.3257	.97430	59
2	.22552	.23148	4.3200	.97424	58
3	.22580	.23179	4.3143	.97417	57
4	.22608	.23209	4.3086	.97411	56
5	.22637	.23240	4.3029	.97404	**55**
6	.22665	.23271	4.2972	.97398	54
7	.22693	.23301	4.2916	.97391	53
8	.22722	.23332	4.2859	.97384	52
9	.22750	.23363	4.2803	.97378	51
10	.22778	.23393	4.2747	.97371	**50**
11	.22807	.23424	4.2691	.97365	49
12	.22835	.23455	4.2635	.97358	48
13	.22863	.23485	4.2580	.97351	47
14	.22892	.23516	4.2524	.97345	46
15	.22920	.23547	4.2468	.97338	**45**
16	.22948	.23578	4.2413	.97331	44
17	.22977	.23608	4.2358	.97325	43
18	.23005	.23639	4.2303	.97318	42
19	.23033	.23670	4.2248	.97311	41
20	.23062	.23700	4.2193	.97304	**40**
21	.23090	.23731	4.2139	.97298	39
22	.23118	.23762	4.2084	.97291	38
23	.23146	.23793	4.2030	.97284	37
24	.23175	.23823	4.1976	.97278	36
25	.23203	.23854	4.1922	.97271	**35**
26	.23231	.23885	4.1868	.97264	34
27	.23260	.23916	4.1814	.97257	33
28	.23288	.23946	4.1760	.97251	32
29	.23316	.23977	4.1706	.97244	31
30	.23345	.24008	4.1653	.97237	**30**
31	.23373	.24039	4.1600	.97230	29
32	.23401	.24069	4.1547	.97223	28
33	.23429	.24100	4.1493	.97217	27
34	.23458	.24131	4.1441	.97210	26
35	.23486	.24162	4.1388	.97203	**25**
36	.23514	.24193	4.1335	.97196	24
37	.23542	.24223	4.1282	.97189	23
38	.23571	.24254	4.1230	.97182	22
39	.23599	.24285	4.1178	.97176	21
40	.23627	.24316	4.1126	.97169	**20**
41	.23656	.24347	4.1074	.97162	19
42	.23684	.24377	4.1022	.97155	18
43	.23712	.24408	4.0970	.97148	17
44	.23740	.24439	4.0918	.97141	16
45	.23769	.24470	4.0867	.97134	**15**
46	.23797	.24501	4.0815	.97127	14
47	.23825	.24532	4.0764	.97120	13
48	.23853	.24562	4.0713	.97113	12
49	.23882	.24593	4.0662	.97106	11
50	.23910	.24624	4.0611	.97100	**10**
51	.23938	.24655	4.0560	.97093	9
52	.23966	.24686	4.0509	.97086	8
53	.23995	.24717	4.0459	.97079	7
54	.24023	.24747	4.0408	.97072	6
55	.24051	.24778	4.0358	.97065	**5**
56	.24079	.24809	4.0308	.97058	4
57	.24108	.24840	4.0257	.97051	3
58	.24136	.24871	4.0207	.97044	2
59	.24164	.24902	4.0158	.97037	1
60	.24192	.24933	4.0108	.97030	**0**
′	Cos	Cot	Tan	Sin	′

103° (283°) (256°) **76°**

14° (194°) (345°) **165°**

′	Sin	Tan	Cot	Cos	′
0	.24192	.24933	4.0108	.97030	**60**
1	.24220	.24964	4.0058	.97023	59
2	.24249	.24995	4.0009	.97015	58
3	.24277	.25026	3.9959	.97008	57
4	.24305	.25056	3.9910	.97001	56
5	.24333	.25087	3.9861	.96994	**55**
6	.24362	.25118	3.9812	.96987	54
7	.24390	.25149	3.9763	.96980	53
8	.24418	.25180	3.9714	.96973	52
9	.24446	.25211	3.9665	.96966	51
10	.24474	.25242	3.9617	.96959	**50**
11	.24503	.25273	3.9568	.96952	49
12	.24531	.25304	3.9520	.96945	48
13	.24559	.25335	3.9471	.96937	47
14	.24587	.25366	3.9423	.96930	46
15	.24615	.25397	3.9375	.96923	**45**
16	.24644	.25428	3.9327	.96916	44
17	.24672	.25459	3.9279	.96909	43
18	.24700	.25490	3.9232	.96902	42
19	.24728	.25521	3.9184	.96894	41
20	.24756	.25552	3.9136	.96887	**40**
21	.24784	.25583	3.9089	.96880	39
22	.24813	.25614	3.9042	.96873	38
23	.24841	.25645	3.8995	.96866	37
24	.24869	.25676	3.8947	.96858	36
25	.24897	.25707	3.8900	.96851	**35**
26	.24925	.25738	3.8854	.96844	34
27	.24954	.25769	3.8807	.96837	33
28	.24982	.25800	3.8760	.96829	32
29	.25010	.25831	3.8714	.96822	31
30	.25038	.25862	3.8667	.96815	**30**
31	.25066	.25893	3.8621	.96807	29
32	.25094	.25924	3.8575	.96800	28
33	.25122	.25955	3.8528	.96793	27
34	.25151	.25986	3.8482	.96786	26
35	.25179	.26017	3.8436	.96778	**25**
36	.25207	.26048	3.8391	.96771	24
37	.25235	.26079	3.8345	.96764	23
38	.25263	.26110	3.8299	.96756	22
39	.25291	.26141	3.8254	.96749	21
40	.25320	.26172	3.8208	.96742	**20**
41	.25348	.26203	3.8163	.96734	19
42	.25376	.26235	3.8118	.96727	18
43	.25404	.26266	3.8073	.96719	17
44	.25432	.26297	3.8028	.96712	16
45	.25460	.26328	3.7983	.96705	**15**
46	.25488	.26359	3.7938	.96697	14
47	.25516	.26390	3.7893	.96690	13
48	.25545	.26421	3.7848	.96682	12
49	.25573	.26452	3.7804	.96675	11
50	.25601	.26483	3.7760	.96667	**10**
51	.25629	.26515	3.7715	.96660	9
52	.25657	.26546	3.7671	.96653	8
53	.25685	.26577	3.7627	.96645	7
54	.25713	.26608	3.7583	.96638	6
55	.25741	.26639	3.7539	.96630	**5**
56	.25769	.26670	3.7495	.96623	4
57	.25798	.26701	3.7451	.96615	3
58	.25826	.26733	3.7408	.96608	2
59	.25854	.26764	3.7364	.96600	1
60	.25882	.26795	3.7321	.96593	**0**
′	Cos	Cot	Tan	Sin	′

15° (195°) (344°) **164°**

′	Sin	Tan	Cot	Cos	′
0	.25882	.26795	3.7321	.96593	**60**
1	.25910	.26826	3.7277	.96585	59
2	.25938	.26857	3.7234	.96578	58
3	.25966	.26888	3.7191	.96570	57
4	.25994	.26920	3.7148	.96562	56
5	.26022	.26951	3.7105	.96555	**55**
6	.26050	.26982	3.7062	.96547	54
7	.26079	.27013	3.7019	.96540	53
8	.26107	.27044	3.6976	.96532	52
9	.26135	.27076	3.6933	.96524	51
10	.26163	.27107	3.6891	.96517	**50**
11	.26191	.27138	3.6848	.96509	19
12	.26219	.27169	3.6806	.96502	48
13	.26247	.27201	3.6764	.96494	47
14	.26275	.27232	3.6722	.96486	46
15	.26303	.27263	3.6680	.96479	**45**
16	.26331	.27294	3.6638	.96471	44
17	.26359	.27326	3.6596	.96463	43
18	.26387	.27357	3.6554	.96456	42
19	.26415	.27388	3.6512	.96448	41
20	.26443	.27419	3.6470	.96440	**40**
21	.26471	.27451	3.6429	.96433	39
22	.26500	.27482	3.6387	.96425	38
23	.26528	.27513	3.6346	.96417	37
24	.26556	.27545	3.6305	.96410	36
25	.26584	.27576	3.6264	.96402	**35**
26	.26612	.27607	3.6222	.96394	34
27	.26640	.27638	3.6181	.96386	33
28	.26668	.27670	3.6140	.96379	32
29	.26696	.27701	3.6100	.96371	31
30	.26724	.27732	3.6059	.96363	**30**
31	.26752	.27764	3.6018	.96355	29
32	.26780	.27795	3.5978	.96347	28
33	.26808	.27826	3.5937	.96340	27
34	.26836	.27858	3.5897	.96332	26
35	.26864	.27889	3.5856	.96324	**25**
36	.26892	.27921	3.5816	.96316	24
37	.26920	.27952	3.5776	.96308	23
38	.26948	.27983	3.5736	.96301	22
39	.26976	.28015	3.5696	.96293	21
40	.27004	.28046	3.5656	.96285	**20**
41	.27032	.28077	3.5616	.96277	19
42	.27060	.28109	3.5576	.96269	18
43	.27088	.28140	3.5536	.96261	17
44	.27116	.28172	3.5497	.96253	16
45	.27144	.28203	3.5457	.96246	**15**
46	.27172	.28234	3.5418	.96238	14
47	.27200	.28266	3.5379	.96230	13
48	.27228	.28297	3.5339	.96222	12
49	.27256	.28329	3.5300	.96214	11
50	.27284	.28360	3.5261	.96206	**10**
51	.27312	.28391	3.5222	.96198	9
52	.27340	.28423	3.5183	.96190	8
53	.27368	.28454	3.5144	.96182	7
54	.27396	.28486	3.5105	.96174	6
55	.27424	.28517	3.5067	.96166	**5**
56	.27452	.28549	3.5028	.96158	4
57	.27480	.28580	3.4989	.96150	3
58	.27508	.28612	3.4951	.96142	2
59	.27536	.28643	3.4912	.96134	1
60	.27564	.28675	3.4874	.96126	**0**
′	Cos	Cot	Tan	Sin	′

04° (284°) (255°) **75°**

105° (285°) (254°) **74°**

16° (196°) (348°) **163°**

′	Sin	Tan	Cot	Cos	′
0	.27564	.28675	3.4874	.96126	**60**
1	.27592	.28706	3.4836	.96118	59
2	.27620	.28738	3.4798	.96110	58
3	.27648	.28769	3.4760	.96102	57
4	.27676	.28801	3.4722	.96094	56
5	.27704	.28832	3.4684	.96085	**55**
6	.27731	.28864	3.4646	.96078	54
7	.27759	.28895	3.4608	.96070	53
8	.27787	.28927	3.4570	.96062	52
9	.27815	.28958	3.4533	.96054	51
10	.27843	.28990	3.4495	.96046	**50**
11	.27871	.29021	3.4458	.96037	49
12	.27899	.29053	3.4420	.96029	48
13	.27927	.29084	3.4383	.96021	47
14	.27955	.29116	3.4346	.96013	46
15	.27983	.29147	3.4308	.96005	**45**
16	.28011	.29179	3.4271	.95997	44
17	.28039	.29210	3.4234	.95989	43
18	.28067	.29242	3.4197	.95981	42
19	.28095	.29274	3.4160	.95972	41
20	.28123	.29305	3.4124	.95964	**40**
21	.28150	.29337	3.4087	.95956	39
22	.28178	.29368	3.4050	.95948	38
23	.28206	.29400	3.4014	.95940	37
24	.28234	.29432	3.3977	.95931	36
25	.28262	.29463	3.3941	.95923	**35**
26	.28290	.29495	3.3904	.95915	34
27	.28318	.29526	3.3868	.95907	33
28	.28346	.29558	3.3832	.95898	32
29	.28374	.29590	3.3796	.95890	31
30	.28402	.29621	3.3759	.95882	**30**
31	.28429	.29653	3.3723	.95874	29
32	.28457	.29685	3.3687	.95865	28
33	.28485	.29716	3.3652	.95857	27
34	.28513	.29748	3.3616	.95849	26
35	.28541	.29780	3.3580	.95841	**25**
36	.28569	.29811	3.3544	.95832	24
37	.28597	.29843	3.3509	.95824	23
38	.28625	.29875	3.3473	.95816	22
39	.28652	.29906	3.3438	.95807	21
40	.28680	.29938	3.3402	.95799	**20**
41	.28708	.29970	3.3367	.95791	19
42	.28736	.30001	3.3332	.95782	18
43	.28764	.30033	3.3297	.95774	17
44	.28792	.30065	3.3261	.95766	16
45	.28820	.30097	3.3226	.95757	**15**
46	.28847	.30128	3.3191	.95749	14
47	.28875	.30160	3.3156	.95740	13
48	.28903	.30192	3.3122	.95732	12
49	.28931	.30224	3.3087	.95724	11
50	.28959	.30255	3.3052	.95715	**10**
51	.28987	.30287	3.3017	.95707	9
52	.29015	.30319	3.2983	.95698	8
53	.29042	.30351	3.2948	.95690	7
54	.29070	.30382	3.2914	.95681	6
55	.29098	.30414	3.2879	.95673	**5**
56	.29126	.30446	3.2845	.95664	4
57	.29154	.30478	3.2811	.95656	3
58	.29182	.30509	3.2777	.95647	2
59	.29209	.30541	3.2743	.95639	1
60	.29237	.30573	3.2709	.95630	**0**
′	Cos	Cot	Tan	Sin	′

106° (286°) (253°) **73°**

17° (197°) (342°) **162°**

′	Sin	Tan	Cot	Cos	′
0	.29237	.30573	3.2709	.95630	**60**
1	.29265	.30605	3.2675	.95622	59
2	.29293	.30637	3.2641	.95613	58
3	.29321	.30669	3.2607	.95605	57
4	.29348	.30700	3.2573	.95596	56
5	.29376	.30732	3.2539	.95588	**55**
6	.29404	.30764	3.2506	.95579	54
7	.29432	.30796	3.2472	.95571	53
8	.29460	.30828	3.2438	.95562	52
9	.29487	.30860	3.2405	.95554	51
10	.29515	.30891	3.2371	.95545	**50**
11	.29543	.30923	3.2338	.95536	49
12	.29571	.30955	3.2305	.95528	48
13	.29599	.30987	3.2272	.95519	47
14	.29626	.31019	3.2238	.95511	46
15	.29654	.31051	3.2205	.95502	**45**
16	.29682	.31083	3.2172	.95493	44
17	.29710	.31115	3.2139	.95485	43
18	.29737	.31147	3.2106	.95476	42
19	.29765	.31178	3.2073	.95467	41
20	.29793	.31210	3.2041	.95459	**40**
21	.29821	.31242	3.2008	.95450	39
22	.29849	.31274	3.1975	.95441	38
23	.29876	.31306	3.1943	.95433	37
24	.29904	.31338	3.1910	.95424	36
25	.29932	.31370	3.1878	.95415	**35**
26	.29960	.31402	3.1845	.95407	34
27	.29987	.31434	3.1813	.95398	33
28	.30015	.31466	3.1780	.95389	32
29	.30043	.31498	3.1748	.95380	31
30	.30071	.31530	3.1716	.95372	**30**
31	.30098	.31562	3.1684	.95363	29
32	.30126	.31594	3.1652	.95354	28
33	.30154	.31626	3.1620	.95345	27
34	.30182	.31658	3.1588	.95337	26
35	.30209	.31690	3.1556	.95328	**25**
36	.30237	.31722	3.1524	.95319	24
37	.30265	.31754	3.1492	.95310	23
38	.30292	.31786	3.1460	.95301	22
39	.30320	.31818	3.1429	.95293	21
40	.30348	.31850	3.1397	.95284	**20**
41	.30376	.31882	3.1366	.95275	19
42	.30403	.31914	3.1334	.95266	18
43	.30431	.31946	3.1303	.95257	17
44	.30459	.31978	3.1271	.95248	16
45	.30486	.32010	3.1240	.95240	**15**
46	.30514	.32042	3.1209	.95231	14
47	.30542	.32074	3.1178	.95222	13
48	.30570	.32106	3.1146	.95213	12
49	.30597	.32139	3.1115	.95204	11
50	.30625	.32171	3.1084	.95195	**10**
51	.30653	.32203	3.1053	.95186	9
52	.30680	.32235	3.1022	.95177	8
53	.30708	.32267	3.0991	.95168	7
54	.30736	.32299	3.0961	.95159	6
55	.30763	.32331	3.0930	.95150	**5**
56	.30791	.32363	3.0899	.95142	4
57	.30819	.32396	3.0868	.95133	3
58	.30846	.32428	3.0838	.95124	2
59	.30874	.32460	3.0807	.95115	1
60	.30902	.32492	3.0777	.95106	**0**
′	Cos	Cot	Tan	Sin	′

107° (287°) (252°) **72°**

18° (198°) (341°) **161°**

′	Sin	Tan	Cot	Cos	′
0	.30902	.32492	3.0777	.95106	**60**
1	.30929	.32524	3.0746	.95097	59
2	.30957	.32556	3.0716	.95088	58
3	.30985	.32588	3.0686	.95079	57
4	.31012	.32621	3.0655	.95070	56
5	.31040	.32653	3.0625	.95061	**55**
6	.31068	.32685	3.0595	.95052	54
7	.31095	.32717	3.0565	.95043	53
8	.31123	.32749	3.0535	.95033	52
9	.31151	.32782	3.0505	.95024	51
10	.31178	.32814	3.0475	.95015	**50**
11	.31206	.32846	3.0445	.95006	49
12	.31233	.32878	3.0415	.94997	48
13	.31261	.32911	3.0385	.94988	47
14	.31289	.32943	3.0356	.94979	46
15	.31316	.32975	3.0326	.94970	**45**
16	.31344	.33007	3.0296	.94961	44
17	.31372	.33040	3.0267	.94952	43
18	.31399	.33072	3.0237	.94943	42
19	.31427	.33104	3.0208	.94933	41
20	.31454	.33136	3.0178	.94924	**40**
21	.31482	.33169	3.0149	.94915	39
22	.31510	.33201	3.0120	.94906	38
23	.31537	.33233	3.0090	.94897	37
24	.31565	.33266	3.0061	.94888	36
25	.31593	.33298	3.0032	.94878	**35**
26	.31620	.33330	3.0003	.94869	34
27	.31648	.33363	2.9974	.94860	33
28	.31675	.33395	2.9945	.94851	32
29	.31703	.33427	2.9916	.94842	31
30	.31730	.33460	2.9887	.94832	**30**
31	.31758	.33492	2.9858	.94823	29
32	.31786	.33524	2.9829	.94814	28
33	.31813	.33557	2.9800	.94805	27
34	.31841	.33589	2.9772	.94795	26
35	.31868	.33621	2.9743	.94786	**25**
36	.31896	.33654	2.9714	.94777	24
37	.31923	.33686	2.9686	.94768	23
38	.31951	.33718	2.9657	.94758	22
39	.31979	.33751	2.9629	.94749	21
40	.32006	.33783	2.9600	.94740	**20**
41	.32034	.33816	2.9572	.94730	19
42	.32061	.33848	2.9544	.94721	18
43	.32089	.33881	2.9515	.94712	17
44	.32116	.33913	2.9487	.94702	16
45	.32144	.33945	2.9459	.94693	**15**
46	.32171	.33978	2.9431	.94684	14
47	.32199	.34010	2.9403	.94674	13
48	.32227	.34043	2.9375	.94665	12
49	.32254	.34075	2.9347	.94656	11
50	.32282	.34108	2.9319	.94646	**10**
51	.32309	.34140	2.9291	.94637	9
52	.32337	.34173	2.9263	.94627	8
53	.32364	.34205	2.9235	.94618	7
54	.32392	.34238	2.9208	.94609	6
55	.32419	.34270	2.9180	.94599	**5**
56	.32447	.34303	2.9152	.94590	4
57	.32474	.34335	2.9125	.94580	3
58	.32502	.34368	2.9097	.94571	2
59	.32529	.34400	2.9070	.94561	1
60	.32557	.34433	2.9042	.94552	**0**
′	Cos	Cot	Tan	Sin	′

108° (288°) (251°) **71°**

19° (199°) (340°) **160°**

′	Sin	Tan	Cot	Cos	′
0	.32557	.34433	2.9042	.94552	**60**
1	.32584	.34465	2.9015	.94542	59
2	.32612	.34498	2.8987	.94533	58
3	.32639	.34530	2.8960	.94523	57
4	.32667	.34563	2.8933	.94514	56
5	.32694	.34596	2.8905	.94504	**55**
6	.32722	.34628	2.8878	.94495	54
7	.32749	.34661	2.8851	.94485	53
8	.32777	.34693	2.8824	.94476	52
9	.32804	.34726	2.8797	.94466	51
10	.32832	.34758	2.8770	.94457	**50**
11	.32859	.34791	2.8743	.94447	49
12	.32887	.34824	2.8716	.94438	48
13	.32914	.34856	2.8689	.94428	47
14	.32942	.34889	2.8662	.94418	46
15	.32969	.34922	2.8636	.94409	**45**
16	.32997	.34954	2.8609	.94399	44
17	.33024	.34987	2.8582	.94390	43
18	.33051	.35020	2.8556	.94380	42
19	.33079	.35052	2.8529	.94370	41
20	.33106	.35085	2.8502	.94361	**40**
21	.33134	.35118	2.8476	.94351	39
22	.33161	.35150	2.8449	.94342	38
23	.33189	.35183	2.8423	.94332	37
24	.33216	.35216	2.8397	.94322	36
25	.33244	.35248	2.8370	.94313	**35**
26	.33271	.35281	2.8344	.94303	34
27	.33298	.35314	2.8318	.94293	33
28	.33326	.35346	2.8291	.94284	32
29	.33353	.35379	2.8265	.94274	31
30	.33381	.35412	2.8239	.94264	**30**
31	.33408	.35445	2.8213	.94254	29
32	.33436	.35477	2.8187	.94245	28
33	.33463	.35510	2.8161	.94235	27
34	.33490	.35543	2.8135	.94225	26
35	.33518	.35576	2.8109	.94215	**25**
36	.33545	.35608	2.8083	.94206	24
37	.33573	.35641	2.8057	.94196	23
38	.33600	.35674	2.8032	.94186	22
39	.33627	.35707	2.8006	.94176	21
40	.33655	.35740	2.7980	.94167	**20**
41	.33682	.35772	2.7955	.94157	19
42	.33710	.35805	2.7929	.94147	18
43	.33737	.35838	2.7903	.94137	17
44	.33764	.35871	2.7878	.94127	16
45	.33792	.35904	2.7852	.94118	**15**
46	.33819	.35937	2.7827	.94108	14
47	.33846	.35969	2.7801	.94098	13
48	.33874	.36002	2.7776	.94088	12
49	.33901	.36035	2.7751	.94078	11
50	.33929	.36068	2.7725	.94068	**10**
51	.33956	.36101	2.7700	.94058	9
52	.33983	.36134	2.7675	.94049	8
53	.34011	.36167	2.7650	.94039	7
54	.34038	.36199	2.7625	.94029	6
55	.34065	.36232	2.7600	.94019	**5**
56	.34093	.36265	2.7575	.94009	4
57	.34120	.36298	2.7550	.93999	3
58	.34147	.36331	2.7525	.93989	2
59	.34175	.36364	2.7500	.93979	1
60	.34202	.36397	2.7475	.93969	**0**
′	Cos	Cot	Tan	Sin	′

109° (289°) (250°) **70°**

20° (200°) (339°) **159°**

′	Sin	Tan	Cot	Cos	′
0	.34202	.36397	2.7475	.93969	60
1	.34229	.36430	2.7450	.93959	59
2	.34257	.36463	2.7425	.93949	58
3	.34284	.36496	2.7400	.93939	57
4	.34311	.36529	2.7376	.93929	56
5	.34339	.36562	2.7351	.93919	55
6	.34366	.36595	2.7326	.93909	54
7	.34393	.36628	2.7302	.93899	53
8	.34421	.36661	2.7277	.93889	52
9	.34448	.36694	2.7253	.93879	51
10	.34475	.36727	2.7228	.93869	50
11	.34503	.36760	2.7204	.93859	49
12	.34530	.36793	2.7179	.93849	48
13	.34557	.36826	2.7155	.93839	47
14	.34584	.36859	2.7130	.93829	46
15	.34612	.36892	2.7106	.93819	45
16	.34639	.36925	2.7082	.93809	44
17	.34666	.36958	2.7058	.93799	43
18	.34694	.36991	2.7034	.93789	42
19	.34721	.37024	2.7009	.93779	41
20	.34748	.37057	2.6985	.93769	40
21	.34775	.37090	2.6961	.93759	39
22	.34803	.37123	2.6937	.93748	38
23	.34830	.37157	2.6913	.93738	37
24	.34857	.37190	2.6889	.93728	36
25	.34884	.37223	2.6865	.93718	35
26	.34912	.37256	2.6841	.93708	34
27	.34939	.37289	2.6818	.93698	33
28	.34966	.37322	2.6794	.93688	32
29	.34993	.37355	2.6770	.93677	31
30	.35021	.37388	2.6746	.93667	30
31	.35048	.37422	2.6723	.93657	29
32	.35075	.37455	2.6699	.93647	28
33	.35102	.37488	2.6675	.93637	27
34	.35130	.37521	2.6652	.93626	26
35	.35157	.37554	2.6628	.93616	25
36	.35184	.37588	2.6605	.93606	24
37	.35211	.37621	2.6581	.93596	23
38	.35239	.37654	2.6558	.93585	22
39	.35266	.37687	2.6534	.93575	21
40	.35293	.37720	2.6511	.93565	20
41	.35320	.37754	2.6488	.93555	19
42	.35347	.37787	2.6464	.93544	18
43	.35375	.37820	2.6441	.93534	17
44	.35402	.37853	2.6418	.93524	16
45	.35429	.37887	2.6395	.93514	15
46	.35456	.37920	2.6371	.93503	14
47	.35484	.37953	2.6348	.93493	13
48	.35511	.37986	2.6325	.93483	12
49	.35538	.38020	2.6302	.93472	11
50	.35565	.38053	2.6279	.93462	10
51	.35592	.38086	2.6256	.93452	9
52	.35619	.38120	2.6233	.93441	8
53	.35647	.38153	2.6210	.93431	7
54	.35674	.38186	2.6187	.93420	6
55	.35701	.38220	2.6165	.93410	5
56	.35728	.38253	2.6142	.93400	4
57	.35755	.38286	2.6119	.93389	3
58	.35782	.38320	2.6096	.93379	2
59	.35810	.38353	2.6074	.93368	1
60	.35837	.38386	2.6051	.93358	0
′	Cos	Cot	Tan	Sin	′

110° (290°) (249°) **69°**

21° (201°) (338°) **158°**

′	Sin	Tan	Cot	Cos	′
0	.35837	.38386	2.6051	.93358	60
1	.35864	.38420	2.6028	.93348	59
2	.35891	.38453	2.6006	.93337	58
3	.35918	.38487	2.5983	.93327	57
4	.35945	.38520	2.5961	.93316	56
5	.35973	.38553	2.5938	.93306	55
6	.36000	.38587	2.5916	.93295	54
7	.36027	.38620	2.5893	.93285	53
8	.36054	.38654	2.5871	.93274	52
9	.36081	.38687	2.5848	.93264	51
10	.36108	.38721	2.5826	.93253	50
11	.36135	.38754	2.5804	.93243	49
12	.36162	.38787	2.5782	.93232	48
13	.36190	.38821	2.5759	.93222	47
14	.36217	.38854	2.5737	.93211	46
15	.36244	.38888	2.5715	.93201	45
16	.36271	.38921	2.5693	.93190	44
17	.36298	.38955	2.5671	.93180	43
18	.36325	.38988	2.5649	.93169	42
19	.36352	.39022	2.5627	.93159	41
20	.36379	.39055	2.5605	.93148	40
21	.36406	.39089	2.5583	.93137	39
22	.36434	.39122	2.5561	.93127	38
23	.36461	.39156	2.5539	.93116	37
24	.36488	.39190	2.5517	.93106	36
25	.36515	.39223	2.5495	.93095	35
26	.36542	.39257	2.5473	.93084	34
27	.36569	.39290	2.5452	.93074	33
28	.36596	.39324	2.5430	.93063	32
29	.36623	.39357	2.5408	.93052	31
30	.36650	.39391	2.5386	.93042	30
31	.36677	.39425	2.5365	.93031	29
32	.36704	.39458	2.5343	.93020	28
33	.36731	.39492	2.5322	.93010	27
34	.36758	.39526	2.5300	.92999	26
35	.36785	.39559	2.5279	.92988	25
36	.36812	.39593	2.5257	.92978	24
37	.36839	.39626	2.5236	.92967	23
38	.36867	.39660	2.5214	.92956	22
39	.36894	.39694	2.5193	.92945	21
40	.36921	.39727	2.5172	.92935	20
41	.36948	.39761	2.5150	.92924	19
42	.36975	.39795	2.5129	.92913	18
43	.37002	.39829	2.5108	.92902	17
44	.37029	.39862	2.5086	.92892	16
45	.37056	.39896	2.5065	.92881	15
46	.37083	.39930	2.5044	.92870	14
47	.37110	.39963	2.5023	.92859	13
48	.37137	.39997	2.5002	.92849	12
49	.37164	.40031	2.4981	.92838	11
50	.37191	.40065	2.4960	.92827	10
51	.37218	.40098	2.4939	.92816	9
52	.37245	.40132	2.4918	.92805	8
53	.37272	.40166	2.4897	.92794	7
54	.37299	.40200	2.4876	.92784	6
55	.37326	.40234	2.4855	.92773	5
56	.37353	.40267	2.4834	.92762	4
57	.37380	.40301	2.4813	.92751	3
58	.37407	.40335	2.4792	.92740	2
59	.37434	.40369	2.4772	.92729	1
60	.37461	.40403	2.4751	.92718	0
′	Cos	Cot	Tan	Sin	′

111° (291°) (248°) **68°**

22° (202°)			(337°) 157°		
′	Sin	Tan	Cot	Cos	′
0	.37461	.40403	2.4751	.92718	60
1	.37488	.40436	2.4730	.92707	59
2	.37515	.40470	2.4709	.92697	58
3	.37542	.40504	2.4689	.92686	57
4	.37569	.40538	2.4668	.92675	56
5	.37595	.40572	2.4648	.92664	55
6	.37622	.40606	2.4627	.92653	54
7	.37649	.40640	2.4606	.92642	53
8	.37676	.40674	2.4586	.92631	52
9	.37703	.40707	2.4566	.92620	51
10	.37730	.40741	2.4545	.92609	50
11	.37757	.40775	2.4525	.92598	49
12	.37784	.40809	2.4504	.92587	48
13	.37811	.40843	2.4484	.92576	47
14	.37838	.40877	2.4464	.92565	46
15	.37865	.40911	2.4443	.92554	45
16	.37892	.40945	2.4423	.92543	44
17	.37919	.40979	2.4403	.92532	43
18	.37946	.41013	2.4383	.92521	42
19	.37973	.41047	2.4362	.92510	41
20	.37999	.41081	2.4342	.92499	40
21	.38026	.41115	2.4322	.92488	39
22	.38053	.41149	2.4302	.92477	38
23	.38080	.41183	2.4282	.92466	37
24	.38107	.41217	2.4262	.92455	36
25	.38134	.41251	2.4242	.92444	35
26	.38161	.41285	2.4222	.92432	34
27	.38188	.41319	2.4202	.92421	33
28	.38215	.41353	2.4182	.92410	32
29	.38241	.41387	2.4162	.92399	31
30	.38268	.41421	2.4142	.92388	30
31	.38295	.41455	2.4122	.92377	29
32	.38322	.41490	2.4102	.92366	28
33	.38349	.41524	2.4083	.92355	27
34	.38376	.41558	2.4063	.92343	26
35	.38403	.41592	2.4043	.92332	25
36	.38430	.41626	2.4023	.92321	24
37	.38456	.41660	2.4004	.92310	23
38	.38483	.41694	2.3984	.92299	22
39	.38510	.41728	2.3964	.92287	21
40	.38537	.41763	2.3945	.92276	20
41	.38564	.41797	2.3925	.92265	19
42	.38591	.41831	2.3906	.92254	18
43	.38617	.41865	2.3886	.92243	17
44	.38644	.41899	2.3867	.92231	16
45	.38671	.41933	2.3847	.92220	15
46	.38698	.41968	2.3828	.92209	14
47	.38725	.42002	2.3808	.92198	13
48	.38752	.42036	2.3789	.92186	12
49	.38778	.42070	2.3770	.92175	11
50	.38805	.42105	2.3750	.92164	10
51	.38832	.42139	2.3731	.92152	9
52	.38859	.42173	2.3712	.92141	8
53	.38886	.42207	2.3693	.92130	7
54	.38912	.42242	2.3673	.92119	6
55	.38939	.42276	2.3654	.92107	5
56	.38966	.42310	2.3635	.92096	4
57	.38993	.42345	2.3616	.92085	3
58	.39020	.42379	2.3597	.92073	2
59	.39046	.42413	2.3578	.92062	1
60	.39073	.42447	2.3559	.92050	0
′	Cos	Cot	Tan	Sin	′
112° (292°)			(247°) 67°		

23° (203°)			(336°) 156°		
′	Sin	Tan	Cot	Cos	′
0	.39073	.42447	2.3559	.92050	60
1	.39100	.42482	2.3539	.92039	59
2	.39127	.42516	2.3520	.92028	58
3	.39153	.42551	2.3501	.92016	57
4	.39180	.42585	2.3483	.92005	56
5	.39207	.42619	2.3464	.91994	55
6	.39234	.42654	2.3445	.91982	54
7	.39260	.42688	2.3426	.91971	53
8	.39287	.42722	2.3407	.91959	52
9	.39314	.42757	2.3388	.91948	51
10	.39341	.42791	2.3369	.91936	50
11	.39367	.42826	2.3351	.91925	49
12	.39394	.42860	2.3332	.91914	48
13	.39421	.42894	2.3313	.91902	47
14	.39448	.42929	2.3294	.91891	46
15	.39474	.42963	2.3276	.91879	45
16	.39501	.42998	2.3257	.91868	44
17	.39528	.43032	2.3238	.91856	43
18	.39555	.43067	2.3220	.91845	42
19	.39581	.43101	2.3201	.91833	41
20	.39608	.43136	2.3183	.91822	40
21	.39635	.43170	2.3164	.91810	39
22	.39661	.43205	2.3146	.91799	38
23	.39688	.43239	2.3127	.91787	37
24	.39715	.43274	2.3109	.91775	36
25	.39741	.43308	2.3090	.91764	35
26	.39768	.43343	2.3072	.91752	34
27	.39795	.43378	2.3053	.91741	33
28	.39822	.43412	2.3035	.91729	32
29	.39848	.43447	2.3017	.91718	31
30	.39875	.43481	2.2998	.91706	30
31	.39902	.43516	2.2980	.91694	29
32	.39928	.43550	2.2962	.91683	28
33	.39955	.43585	2.2944	.91671	27
34	.39982	.43620	2.2925	.91660	26
35	.40008	.43654	2.2907	.91648	25
36	.40035	.43689	2.2889	.91636	24
37	.40062	.43724	2.2871	.91625	23
38	.40088	.43758	2.2853	.91613	22
39	.40115	.43793	2.2835	.91601	21
40	.40141	.43828	2.2817	.91590	20
41	.40168	.43862	2.2799	.91578	19
42	.40195	.43897	2.2781	.91566	18
43	.40221	.43932	2.2763	.91555	17
44	.40248	.43966	2.2745	.91543	16
45	.40275	.44001	2.2727	.91531	15
46	.40301	.44036	2.2709	.91519	14
47	.40328	.44071	2.2691	.91508	13
48	.40355	.44105	2.2673	.91496	12
49	.40381	.44140	2.2655	.91484	11
50	.40408	.44175	2.2637	.91472	10
51	.40434	.44210	2.2620	.91461	9
52	.40461	.44244	2.2602	.91449	8
53	.40488	.44279	2.2584	.91437	7
54	.40514	.44314	2.2566	.91425	6
55	.40541	.44349	2.2549	.91414	5
56	.40567	.44384	2.2531	.91402	4
57	.40594	.44418	2.2513	.91390	3
58	.40621	.44453	2.2496	.91378	2
59	.40647	.44488	2.2478	.91366	1
60	.40674	.44523	2.2460	.91355	0
′	Cos	Cot	Tan	Sin	′
113° (293°)			(246°) 66°		

′	Sin	Tan	Cot	Cos	′
24° (204°)				(335°) **155°**	
0	.40674	.44523	2.2460	.91355	**60**
1	.40700	.44558	2.2443	.91343	59
2	.40727	.44593	2.2425	.91331	58
3	.40753	.44627	2.2408	.91319	57
4	.40780	.44662	2.2390	.91307	56
5	.40806	.44697	2.2373	.91295	**55**
6	.40833	.44732	2.2355	.91283	54
7	.40860	.44767	2.2338	.91272	53
8	.40886	.44802	2.2320	.91260	52
9	.40913	.44837	2.2303	.91248	51
10	.40939	.44872	2.2286	.91236	**50**
11	.40966	.44907	2.2268	.91224	49
12	.40992	.44942	2.2251	.91212	48
13	.41019	.44977	2.2234	.91200	47
14	.41045	.45012	2.2216	.91188	46
15	.41072	.45047	2.2199	.91176	**45**
16	.41098	.45082	2.2182	.91164	44
17	.41125	.45117	2.2165	.91152	43
18	.41151	.45152	2.2148	.91140	42
19	.41178	.45187	2.2130	.91128	41
20	.41204	.45222	2.2113	.91116	**40**
21	.41231	.45257	2.2096	.91104	39
22	.41257	.45292	2.2079	.91092	38
23	.41284	.45327	2.2062	.91080	37
24	.41310	.45362	2.2045	.91068	36
25	.41337	.45397	2.2028	.91056	**35**
26	.41363	.45432	2.2011	.91044	34
27	.41390	.45467	2.1994	.91032	33
28	.41416	.45502	2.1977	.91020	32
29	.41443	.45538	2.1960	.91008	31
30	.41469	.45573	2.1943	.90996	**30**
31	.41496	.45608	2.1926	.90984	29
32	.41522	.45643	2.1909	.90972	28
33	.41549	.45678	2.1892	.90960	27
34	.41575	.45713	2.1876	.90948	26
35	.41602	.45748	2.1859	.90936	**25**
36	.41628	.45784	2.1842	.90924	24
37	.41655	.45819	2.1825	.90911	23
38	.41681	.45854	2.1808	.90899	22
39	.41707	.45889	2.1792	.90887	21
40	.41734	.45924	2.1775	.90875	**20**
41	.41760	.45960	2.1758	.90863	19
42	.41787	.45995	2.1742	.90851	18
43	.41813	.46030	2.1725	.90839	17
44	.41840	.46065	2.1708	.90826	16
45	.41866	.46101	2.1692	.90814	**15**
46	.41892	.46136	2.1675	.90802	14
47	.41919	.46171	2.1659	.90790	13
48	.41945	.46206	2.1642	.90778	12
49	.41972	.46242	2.1625	.90766	11
50	.41998	.46277	2.1609	.90753	**10**
51	.42024	.46312	2.1592	.90741	9
52	.42051	.46348	2.1576	.90729	8
53	.42077	.46383	2.1560	.90717	7
54	.42104	.46418	2.1543	.90704	6
55	.42130	.46454	2.1527	.90692	**5**
56	.42156	.46489	2.1510	.90680	4
57	.42183	.46525	2.1494	.90668	3
58	.42209	.46560	2.1478	.90655	2
59	.42235	.46595	2.1461	.90643	1
60	.42262	.46631	2.1445	.90631	**0**
′	Cos	Cot	Tan	Sin	′
114° (294°)				(245°) **65°**	

′	Sin	Tan	Cot	Cos	′
25° (205°)				(334°) **154°**	
0	.42262	.46631	2.1445	.90631	**60**
1	.42288	.46666	2.1429	.90618	59
2	.42315	.46702	2.1413	.90606	58
3	.42341	.46737	2.1396	.90594	57
4	.42367	.46772	2.1380	.90582	56
5	.42394	.46808	2.1364	.90569	**55**
6	.42420	.46843	2.1348	.90557	54
7	.42446	.46879	2.1332	.90545	53
8	.42473	.46914	2.1315	.90532	52
9	.42499	.46950	2.1299	.90520	51
10	.42525	.46985	2.1283	.90507	**50**
11	.42552	.47021	2.1267	.90495	49
12	.42578	.47056	2.1251	.90483	48
13	.42604	.47092	2.1235	.90470	47
14	.42631	.47128	2.1219	.90458	46
15	.42657	.47163	2.1203	.90446	**45**
16	.42683	.47199	2.1187	.90433	44
17	.42709	.47234	2.1171	.90421	43
18	.42736	.47270	2.1155	.90408	42
19	.42762	.47305	2.1139	.90396	41
20	.42788	.47341	2.1123	.90383	**40**
21	.42815	.47377	2.1107	.90371	39
22	.42841	.47412	2.1092	.90358	38
23	.42867	.47448	2.1076	.90346	37
24	.42894	.47483	2.1060	.90334	36
25	.42920	.47519	2.1044	.90321	**35**
26	.42946	.47555	2.1028	.90309	34
27	.42972	.47590	2.1013	.90296	33
28	.42999	.47626	2.0997	.90284	32
29	.43025	.47662	2.0981	.90271	31
30	.43051	.47698	2.0965	.90259	**30**
31	.43077	.47733	2.0950	.90246	29
32	.43104	.47769	2.0934	.90233	28
33	.43130	.47805	2.0918	.90221	27
34	.43156	.47840	2.0903	.90208	26
35	.43182	.47876	2.0887	.90196	**25**
36	.43209	.47912	2.0872	.90183	24
37	.43235	.47948	2.0856	.90171	23
38	.43261	.47984	2.0840	.90158	22
39	.43287	.48019	2.0825	.90146	21
40	.43313	.48055	2.0809	.90133	**20**
41	.43340	.48091	2.0794	.90120	19
42	.43366	.48127	2.0778	.90108	18
43	.43392	.48163	2.0763	.90095	17
44	.43418	.48198	2.0748	.90082	16
45	.43445	.48234	2.0732	.90070	**15**
46	.43471	.48270	2.0717	.90057	14
47	.43497	.48306	2.0701	.90045	13
48	.43523	.48342	2.0686	.90032	12
49	.43549	.48378	2.0671	.90019	11
50	.43575	.48414	2.0655	.90007	**10**
51	.43602	.48450	2.0640	.89994	9
52	.43628	.48486	2.0625	.89981	8
53	.43654	.48521	2.0609	.89968	7
54	.43680	.48557	2.0594	.89956	6
55	.43706	.48593	2.0579	.89943	**5**
56	.43733	.48629	2.0564	.89930	4
57	.43759	.48665	2.0549	.89918	3
58	.43785	.48701	2.0533	.89905	2
59	.43811	.48737	2.0518	.89892	1
60	.43837	.48773	2.0503	.89879	**0**
′	Cos	Cot	Tan	Sin	′
115° (295°)				(244°) **64**	

6° (206°)				(333°) 153°	
′	Sin	Tan	Cot	Cos	′
0	.43837	.48773	2.0503	.89879	60
1	.43863	.48809	2.0488	.89867	59
2	.43889	.48845	2.0473	.89854	58
3	.43916	.48881	2.0458	.89841	57
4	.43942	.48917	2.0443	.89828	56
5	.43968	.48953	2.0428	.89816	55
6	.43994	.48989	2.0413	.89803	54
7	.44020	.49026	2.0398	.89790	53
8	.44046	.49062	2.0383	.89777	52
9	.44072	.49098	2.0368	.89764	51
10	.44098	.49134	2.0353	.89752	50
11	.44124	.49170	2.0338	.89739	49
12	.44151	.49206	2.0323	.89726	48
13	.44177	.49242	2.0308	.89713	47
14	.44203	.49278	2.0293	.89700	46
15	.44229	.49315	2.0278	.89687	45
16	.44255	.49351	2.0263	.89674	44
17	.44281	.49387	2.0248	.89662	43
18	.44307	.49423	2.0233	.89649	12
19	.44333	.49459	2.0219	.89636	41
20	.44359	.49495	2.0204	.89623	40
21	.44385	.49532	2.0189	.89610	39
22	.44411	.49568	2.0174	.89597	38
23	.44437	.49604	2.0160	.89584	37
24	.44464	.49640	2.0145	.89571	36
25	.44490	.49677	2.0130	.89558	35
26	.44516	.49713	2.0115	.89545	34
27	.44542	.49749	2.0101	.89532	33
28	.44568	.49786	2.0086	.89519	32
29	.44594	.49822	2.0072	.89506	31
30	.44620	.49858	2.0057	.89493	30
31	.44646	.49894	2.0042	.89480	29
32	.44672	.49931	2.0028	.89467	28
33	.44698	.49967	2.0013	.89454	27
34	.44724	.50004	1.9999	.89441	26
35	.44750	.50040	1.9984	.89428	25
36	.44776	.50076	1.9970	.89415	24
37	.44802	.50113	1.9955	.89402	23
38	.44828	.50149	1.9941	.89389	22
39	.44854	.50185	1.9926	.89376	21
40	.44880	.50222	1.9912	.89363	20
41	.44906	.50258	1.9897	.89350	19
42	.44932	.50295	1.9883	.89337	18
43	.44958	.50331	1.9868	.89324	17
44	.44984	.50368	1.9854	.89311	16
45	.45010	.50404	1.9840	.89298	15
46	.45036	.50441	1.9825	.89285	14
47	.45062	.50477	1.9811	.89272	13
48	.45088	.50514	1.9797	.89259	12
49	.45114	.50550	1.9782	.89245	11
50	.45140	.50587	1.9768	.89232	10
51	.45166	.50623	1.9754	.89219	9
52	.45192	.50660	1.9740	.89206	8
53	.45218	.50696	1.9725	.89193	7
54	.45243	.50733	1.9711	.89180	6
55	.45269	.50769	1.9697	.89167	5
56	.45295	.50806	1.9683	.89153	4
57	.45321	.50843	1.9669	.89140	3
58	.45347	.50879	1.9654	.89127	2
59	.45373	.50916	1.9640	.89114	1
60	.45399	.50953	1.9626	.89101	0
′	Cos	Cot	Tan	Sin	′
16° (296°)				(243°) 63°	

27° (207°)				(332°) 152°	
′	Sin	Tan	Cot	Cos	′
0	.45399	.50953	1.9626	.89101	60
1	.45425	.50989	1.9612	.89087	59
2	.45451	.51026	1.9598	.89074	58
3	.45477	.51063	1.9584	.89061	57
4	.45503	.51099	1.9570	.89048	56
5	.45529	.51136	1.9556	.89035	55
6	.45554	.51173	1.9542	.89021	54
7	.45580	.51209	1.9528	.89008	53
8	.45606	.51246	1.9514	.88995	52
9	.45632	.51283	1.9500	.88981	51
10	.45658	.51319	1.9486	.88968	50
11	.45684	.51356	1.9472	.88955	49
12	.45710	.51393	1.9458	.88942	48
13	.45736	.51430	1.9444	.88928	47
14	.45762	.51467	1.9430	.88915	46
15	.45787	.51503	1.9416	.88902	45
16	.45813	.51540	1.9402	.88888	44
17	.45839	.51577	1.9388	.88875	43
18	.45865	.51614	1.9375	.88862	42
19	.45891	.51651	1.9361	.88848	41
20	.45917	.51688	1.9347	.88835	40
21	.45942	.51724	1.9333	.88822	39
22	.45968	.51761	1.9319	.88808	38
23	.45994	.51798	1.9306	.88795	37
24	.46020	.51835	1.9292	.88782	36
25	.46046	.51872	1.9278	.88768	35
26	.46072	.51909	1.9265	.88755	34
27	.46097	.51946	1.9251	.88741	33
28	.46123	.51983	1.9237	.88728	32
29	.46149	.52020	1.9223	.88715	31
30	.46175	.52057	1.9210	.88701	30
31	.46201	.52094	1.9196	.88688	29
32	.46226	.52131	1.9183	.88674	28
33	.46252	.52168	1.9169	.88661	27
34	.46278	.52205	1.9155	.88647	26
35	.46304	.52242	1.9142	.88634	25
36	.46330	.52279	1.9128	.88620	24
37	.46355	.52316	1.9115	.88607	23
38	.46381	.52353	1.9101	.88593	22
39	.46407	.52390	1.9088	.88580	21
40	.46433	.52427	1.9074	.88566	20
41	.46458	.52464	1.9061	.88553	19
42	.46484	.52501	1.9047	.88539	18
43	.46510	.52538	1.9034	.88526	17
44	.46536	.52575	1.9020	.88512	16
45	.46561	.52613	1.9007	.88499	15
46	.46587	.52650	1.8993	.88485	14
47	.46613	.52687	1.8980	.88472	13
48	.46639	.52724	1.8967	.88458	12
49	.46664	.52761	1.8953	.88445	11
50	.46690	.52798	1.8940	.88431	10
51	.46716	.52836	1.8927	.88417	9
52	.46742	.52873	1.8913	.88404	8
53	.46767	.52910	1.8900	.88390	7
54	.46793	.52947	1.8887	.88377	6
55	.46819	.52985	1.8873	.88363	5
56	.46844	.53022	1.8860	.88349	4
57	.46870	.53059	1.8847	.88336	3
58	.46896	.53096	1.8834	.88322	2
59	.46921	.53134	1.8820	.88308	1
60	.46947	.53171	1.8807	.88295	0
′	Cos	Cot	Tan	Sin	′
117° (297°)				(242°) 62°	

28° (208°) (331°) **151°**

′	Sin	Tan	Cot	Cos	′
0	.46947	.53171	1.8807	.88295	60
1	.46973	.53208	1.8794	.88281	59
2	.46999	.53246	1.8781	.88267	58
3	.47024	.53283	1.8768	.88254	57
4	.47050	.53320	1.8755	.88240	56
5	.47076	.53358	1.8741	.88226	55
6	.47101	.53395	1.8728	.88213	54
7	.47127	.53432	1.8715	.88199	53
8	.47153	.53470	1.8702	.88185	52
9	.47178	.53507	1.8689	.88172	51
10	.47204	.53545	1.8676	.88158	50
11	.47229	.53582	1.8663	.88144	49
12	.47255	.53620	1.8650	.88130	48
13	.47281	.53657	1.8637	.88117	47
14	.47306	.53694	1.8624	.88103	46
15	.47332	.53732	1.8611	.88089	45
16	.47358	.53769	1.8598	.88075	44
17	.47383	.53807	1.8585	.88062	43
18	.47400	.53844	1.8572	.88048	42
19	.47434	.53882	1.8559	.88034	41
20	.47460	.53920	1.8546	.88020	40
21	.47486	.53957	1.8533	.88006	39
22	.47511	.53995	1.8520	.87993	38
23	.47537	.54032	1.8507	.87979	37
24	.47562	.54070	1.8495	.87965	36
25	.47588	.54107	1.8482	.87951	35
26	.47614	.54145	1.8469	.87937	34
27	.47639	.54183	1.8456	.87923	33
28	.47665	.54220	1.8443	.87909	32
29	.47690	.54258	1.8430	.87896	31
30	.47716	.54296	1.8418	.87882	30
31	.47741	.54333	1.8405	.87868	29
32	.47767	.54371	1.8392	.87854	28
33	.47793	.54409	1.8379	.87840	27
34	.47818	.54446	1.8367	.87826	26
35	.47844	.54484	1.8354	.87812	25
36	.47869	.54522	1.8341	.87798	24
37	.47895	.54560	1.8329	.87784	23
38	.47920	.54597	1.8316	.87770	22
39	.47946	.54635	1.8303	.87756	21
40	.47971	.54673	1.8291	.87743	20
41	.47997	.54711	1.8278	.87729	19
42	.48022	.54748	1.8265	.87715	18
43	.48048	.54786	1.8253	.87701	17
44	.48073	.54824	1.8240	.87687	16
45	.48099	.54862	1.8228	.87673	15
46	.48124	.54900	1.8215	.87659	14
47	.48150	.54938	1.8202	.87645	13
48	.48175	.54975	1.8190	.87631	12
49	.48201	.55013	1.8177	.87617	11
50	.48226	.55051	1.8165	.87603	10
51	.48252	.55089	1.8152	.87589	9
52	.48277	.55127	1.8140	.87575	8
53	.48303	.55165	1.8127	.87561	7
54	.48328	.55203	1.8115	.87546	6
55	.48354	.55241	1.8103	.87532	5
56	.48379	.55279	1.8090	.87518	4
57	.48405	.55317	1.8078	.87504	3
58	.48430	.55355	1.8065	.87490	2
59	.48456	.55393	1.8053	.87476	1
60	.48481	.55431	1.8040	.87462	0
′	Cos	Cot	Tan	Sin	′

118° (298°) (241°) **61°**

29° (209°) (330°) **150°**

′	Sin	Tan	Cot	Cos	′
0	.48481	.55431	1.8040	.87462	60
1	.48506	.55469	1.8028	.87448	59
2	.48532	.55507	1.8016	.87434	58
3	.48557	.55545	1.8003	.87420	57
4	.48583	.55583	1.7991	.87406	56
5	.48608	.55621	1.7979	.87391	55
6	.48634	.55659	1.7966	.87377	54
7	.48659	.55697	1.7954	.87363	53
8	.48684	.55736	1.7942	.87349	52
9	.48710	.55774	1.7930	.87335	51
10	.48735	.55812	1.7917	.87321	50
11	.48761	.55850	1.7905	.87306	49
12	.48786	.55888	1.7893	.87292	48
13	.48811	.55926	1.7881	.87278	47
14	.48837	.55964	1.7868	.87264	46
15	.48862	.56003	1.7856	.87250	45
16	.48888	.56041	1.7844	.87235	44
17	.48913	.56079	1.7832	.87221	43
18	.48938	.56117	1.7820	.87207	42
19	.48964	.56156	1.7808	.87193	41
20	.48989	.56194	1.7796	.87178	40
21	.49014	.56232	1.7783	.87164	39
22	.49040	.56270	1.7771	.87150	38
23	.49065	.56309	1.7759	.87136	37
24	.49090	.56347	1.7747	.87121	36
25	.49116	.56385	1.7735	.87107	35
26	.49141	.56424	1.7723	.87093	34
27	.49166	.56462	1.7711	.87079	33
28	.49192	.56501	1.7699	.87064	32
29	.49217	.56539	1.7687	.87050	31
30	.49242	.56577	1.7675	.87036	30
31	.49268	.56616	1.7663	.87021	29
32	.49293	.56654	1.7651	.87007	28
33	.49318	.56693	1.7639	.86993	27
34	.49344	.56731	1.7627	.86978	26
35	.49369	.56769	1.7615	.86964	25
36	.49394	.56808	1.7603	.86949	24
37	.49419	.56846	1.7591	.86935	23
38	.49445	.56885	1.7579	.86921	22
39	.49470	.56923	1.7567	.86906	21
40	.49495	.56962	1.7556	.86892	20
41	.49521	.57000	1.7544	.86878	19
42	.49546	.57039	1.7532	.86863	18
43	.49571	.57078	1.7520	.86849	17
44	.49596	.57116	1.7508	.86834	16
45	.49622	.57155	1.7496	.86820	15
46	.49647	.57193	1.7485	.86805	14
47	.49672	.57232	1.7473	.86791	13
48	.49697	.57271	1.7461	.86777	12
49	.49723	.57309	1.7449	.86762	11
50	.49748	.57348	1.7437	.86748	10
51	.49773	.57386	1.7426	.86733	9
52	.49798	.57425	1.7414	.86719	8
53	.49824	.57464	1.7402	.86704	7
54	.49849	.57503	1.7391	.86690	6
55	.49874	.57541	1.7379	.86675	5
56	.49899	.57580	1.7367	.86661	4
57	.49924	.57619	1.7355	.86646	3
58	.49950	.57657	1.7344	.86632	2
59	.49975	.57696	1.7332	.86617	1
60	.50000	.57735	1.7321	.86603	0
′	Cos	Cot	Tan	Sin	′

119° (299°) (240°) **60°**

′	Sin	Tan	Cot	Cos	′
30° (210°)				(329°) **149°**	
0	.50000	.57735	1.7321	.86603	**60**
1	.50025	.57774	1.7309	.86588	59
2	.50050	.57813	1.7297	.86573	58
3	.50076	.57851	1.7286	.86559	57
4	.50101	.57890	1.7274	.86544	56
5	.50126	.57929	1.7262	.86530	**55**
6	.50151	.57968	1.7251	.86515	54
7	.50176	.58007	1.7239	.86501	53
8	.50201	.58046	1.7228	.86486	52
9	.50227	.58085	1.7216	.86471	51
10	.50252	.58124	1.7205	.86457	**50**
11	.50277	.58162	1.7193	.86442	49
12	.50302	.58201	1.7182	.86427	48
13	.50327	.58240	1.7170	.86413	47
14	.50352	.58279	1.7159	.86398	46
15	.50377	.58318	1.7147	.86384	**45**
16	.50403	.58357	1.7136	.86369	44
17	.50428	.58396	1.7124	.86354	43
18	.50453	.58435	1.7113	.86340	42
19	.50478	.58474	1.7102	.86325	41
20	.50503	.58513	1.7090	.86310	**40**
21	.50528	.58552	1.7079	.86295	39
22	.50553	.58591	1.7067	.86281	38
23	.50578	.58631	1.7056	.86266	37
24	.50603	.58670	1.7045	.86251	36
25	.50628	.58709	1.7033	.86237	**35**
26	.50654	.58748	1.7022	.86222	34
27	.50679	.58787	1.7011	.86207	33
28	.50704	.58826	1.6999	.86192	32
29	.50729	.58865	1.6988	.86178	31
30	.50754	.58905	1.6977	.86163	**30**
31	.50779	.58944	1.6965	.86148	29
32	.50804	.58983	1.6954	.86133	28
33	.50829	.59022	1.6943	.86119	27
34	.50854	.59061	1.6932	.86104	26
35	.50879	.59101	1.6920	.86089	**25**
36	.50904	.59140	1.6909	.86074	24
37	.50929	.59179	1.6898	.86059	23
38	.50954	.59218	1.6887	.86045	22
39	.50979	.59258	1.6875	.86030	21
40	.51004	.59297	1.6864	.86015	**20**
41	.51029	.59336	1.6853	.86000	19
42	.51054	.59376	1.6842	.85985	18
43	.51079	.59415	1.6831	.85970	17
44	.51104	.59454	1.6820	.85956	16
45	.51129	.59494	1.6808	.85941	**15**
46	.51154	.59533	1.6797	.85926	14
47	.51179	.59573	1.6786	.85911	13
48	.51204	.59612	1.6775	.85896	12
49	.51229	.59651	1.6764	.85881	11
50	.51254	.59691	1.6753	.85866	**10**
51	.51279	.59730	1.6742	.85851	9
52	.51304	.59770	1.6731	.85836	8
53	.51329	.59809	1.6720	.85821	7
54	.51354	.59849	1.6709	.85806	6
55	.51379	.59888	1.6698	.85792	**5**
56	.51404	.59928	1.6687	.85777	4
57	.51429	.59967	1.6676	.85762	3
58	.51454	.60007	1.6665	.85747	2
59	.51479	.60046	1.6654	.85732	1
60	.51504	.60086	1.6643	.85717	**0**
′	Cos	Cot	Tan	Sin	′
0° (300°)				(239°) **59°**	

′	Sin	Tan	Cot	Cos	′
31° (211°)				(328°) **148°**	
0	.51504	.60086	1.6643	.85717	**60**
1	.51529	.60126	1.6632	.85702	59
2	.51554	.60165	1.6621	.85687	58
3	.51579	.60205	1.6610	.85672	57
4	.51604	.60245	1.6599	.85657	56
5	.51628	.60284	1.6588	.85642	**55**
6	.51653	.60324	1.6577	.85627	54
7	.51678	.60364	1.6566	.85612	53
8	.51703	.60403	1.6555	.85597	52
9	.51728	.60443	1.6545	.85582	51
10	.51753	.60483	1.6534	.85567	**50**
11	.51778	.60522	1.6523	.85551	49
12	.51803	.60562	1.6512	.85536	48
13	.51828	.60602	1.6501	.85521	47
14	.51852	.60642	1.6490	.85506	46
15	.51877	.60681	1.6479	.85491	**45**
16	.51902	.60721	1.6469	.85476	44
17	.51927	.60761	1.6458	.85461	43
18	.51952	.60801	1.6447	.85446	42
19	.51977	.60841	1.6436	.85431	41
20	.52002	.60881	1.6426	.85416	**40**
21	.52026	.60921	1.6415	.85401	39
22	.52051	.60960	1.6404	.85385	38
23	.52076	.61000	1.6393	.85370	37
24	.52101	.61040	1.6383	.85355	36
25	.52126	.61080	1.6372	.85340	**35**
26	.52151	.61120	1.6361	.85325	34
27	.52175	.61160	1.6351	.85310	33
28	.52200	.61200	1.6340	.85294	32
29	.52225	.61240	1.6329	.85279	31
30	.52250	.61280	1.6319	.85264	**30**
31	.52275	.61320	1.6308	.85249	29
32	.52299	.61360	1.6297	.85234	28
33	.52324	.61400	1.6287	.85218	27
34	.52349	.61440	1.6276	.85203	26
35	.52374	.61480	1.6265	.85188	**25**
36	.52399	.61520	1.6255	.85173	24
37	.52423	.61561	1.6244	.85157	23
38	.52448	.61601	1.6234	.85142	22
39	.52473	.61641	1.6223	.85127	21
40	.52498	.61681	1.6212	.85112	**20**
41	.52522	.61721	1.6202	.85096	19
42	.52547	.61761	1.6191	.85081	18
43	.52572	.61801	1.6181	.85066	17
44	.52597	.61842	1.6170	.85051	16
45	.52621	.61882	1.6160	.85035	**15**
46	.52646	.61922	1.6149	.85020	14
47	.52671	.61962	1.6139	.85005	13
48	.52696	.62003	1.6128	.84989	12
49	.52720	.62043	1.6118	.84974	11
50	.52745	.62083	1.6107	.84959	**10**
51	.52770	.62124	1.6097	.84943	9
52	.52794	.62164	1.6087	.84928	8
53	.52819	.62204	1.6076	.84913	7
54	.52844	.62245	1.6066	.84897	6
55	.52869	.62285	1.6055	.84882	**5**
56	.52893	.62325	1.6045	.84866	4
57	.52918	.62366	1.6034	.84851	3
58	.52943	.62406	1.6024	.84836	2
59	.52967	.62446	1.6014	.84820	1
60	.52992	.62487	1.6003	.84805	**0**
′	Cos	Cot	Tan	Sin	′
121° (301°)				(238°) **58°**	

32° (212°) **(327°) 147°**

′	Sin	Tan	Cot	Cos	′
0	.52992	.62487	1.6003	.84805	60
1	.53017	.62527	1.5993	.84789	59
2	.53041	.62568	1.5983	.84774	58
3	.53066	.62608	1.5972	.84759	57
4	.53091	.62649	1.5962	.84743	56
5	.53115	.62689	1.5952	.84728	55
6	.53140	.62730	1.5941	.84712	54
7	.53164	.62770	1.5931	.84697	53
8	.53189	.62811	1.5921	.84681	52
9	.53214	.62852	1.5911	.84666	51
10	.53238	.62892	1.5900	.84650	50
11	.53263	.62933	1.5890	.84635	46
12	.53288	.62973	1.5880	.84619	48
13	.53312	.63014	1.5869	.84604	47
14	.53337	.63055	1.5859	.84588	46
15	.53361	.63095	1.5849	.84573	45
16	.53386	.63136	1.5839	.84557	44
17	.53411	.63177	1.5829	.84542	43
18	.53435	.63217	1.5818	.84526	42
19	.53460	.63258	1.5808	.84511	41
20	.53484	.63299	1.5798	.84495	40
21	.53509	.63340	1.5788	.84480	39
22	.53534	.63380	1.5778	.84464	38
23	.53558	.63421	1.5768	.84448	37
24	.53583	.63462	1.5757	.84433	36
25	.53607	.63503	1.5747	.84417	35
26	.53632	.63544	1.5737	.84402	34
27	.53656	.63584	1.5727	.84386	33
28	.53681	.63625	1.5717	.84370	32
29	.53705	.63666	1.5707	.84355	31
30	.53730	.63707	1.5697	.84339	30
31	.53754	.63748	1.5687	.84324	29
32	.53779	.63789	1.5677	.84308	28
33	.53804	.63830	1.5667	.84292	27
34	.53828	.63871	1.5657	.84277	26
35	.53853	.63912	1.5647	.84261	25
36	.53877	.63953	1.5637	.84245	24
37	.53902	.63994	1.5627	.84230	23
38	.53926	.64035	1.5617	.84214	22
39	.53951	.64076	1.5607	.84198	21
40	.53975	.64117	1.5597	.84182	20
41	.54000	.64158	1.5587	.84167	19
42	.54024	.64199	1.5577	.84151	18
43	.54049	.64240	1.5567	.84135	17
44	.54073	.64281	1.5557	.84120	16
45	.54097	.64322	1.5547	.84104	15
46	.54122	.64363	1.5537	.84088	14
47	.54146	.64404	1.5527	.84072	13
48	.54171	.64446	1.5517	.84057	12
49	.54195	.64487	1.5507	.84041	11
50	.54220	.64528	1 5497	.84025	10
51	.54244	.64569	1.5487	.84009	9
52	.54269	.64610	1.5477	.83994	8
53	.54293	.64652	1.5468	.83978	7
54	.54317	.64693	1.5458	.83962	6
55	.54342	.64734	1.5448	.83946	5
56	.54366	.64775	1.5438	.83930	4
57	.54391	.64817	1.5428	.83915	3
58	.54415	.64858	1.5418	.83899	2
59	.54440	.64899	1.5408	.83883	1
60	.54464	.64941	1.5399	.83867	0
′	Cos	Cot	Tan	Sin	′

122° (302°) **(237°) 57°**

33° (213°) **(326°) 146°**

′	Sin	Tan	Cot	Cos	′
0	.54464	.64941	1.5399	.83867	60
1	.54488	.64982	1.5389	.83851	59
2	.54513	.65024	1.5379	.83835	58
3	.54537	.65065	1.5369	.83819	57
4	.54561	.65106	1.5359	.83804	56
5	.54586	.65148	1.5350	.83788	55
6	.54610	.65189	1.5340	.83772	54
7	.54635	.65231	1.5330	.83756	53
8	.54659	.65272	1.5320	.83740	52
9	.54683	.65314	1.5311	.83724	51
10	.54708	.65355	1.5301	.83708	50
11	.54732	.65397	1.5291	.83692	49
12	.54756	.65438	1.5282	.83676	48
13	.54781	.65480	1.5272	.83660	47
14	.54805	.65521	1.5262	.83645	46
15	.54829	.65563	1.5253	.83629	45
16	.54854	.65604	1.5243	.83613	44
17	.54878	.65646	1.5233	.83597	43
18	.54902	.65688	1.5224	.83581	42
19	.54927	.65729	1.5214	.83565	41
20	.54951	.65771	1.5204	.83549	40
21	.54975	.65813	1.5195	.83533	39
22	.54999	.65854	1.5185	.83517	38
23	.55024	.65896	1.5175	.83501	37
24	.55048	.65938	1.5166	.83485	36
25	.55072	.65980	1.5156	.83469	35
26	.55097	.66021	1.5147	.83453	34
27	.55121	.66063	1.5137	.83437	33
28	.55145	.66105	1.5127	.83421	32
29	.55169	.66147	1.5118	.83405	31
30	.55194	.66189	1.5108	.83389	30
31	.55218	.66230	1.5099	.83373	29
32	.55242	.66272	1.5089	.83356	28
33	.55266	.66314	1.5080	.83340	27
34	.55291	.66356	1.5070	.83324	26
35	.55315	.66398	1.5061	.83308	25
36	.55339	.66440	1.5051	.83292	24
37	.55363	.66482	1.5042	.83276	23
38	.55388	.66524	1.5032	.83260	22
39	.55412	.66566	1.5023	.83244	21
40	.55436	.66608	1.5013	.83228	20
41	.55460	.66650	1.5004	.83212	19
42	.55484	.66692	1.4994	.83195	18
43	.55509	.66734	1.4985	.83179	17
44	.55533	.66776	1.4975	.83163	16
45	.55557	.66818	1.4966	.83147	15
46	.55581	.66860	1.4957	.83131	14
47	.55605	.66902	1.4947	.83115	13
48	.55630	.66944	1.4938	.83098	12
49	.55654	.66986	1.4928	.83082	11
50	.55678	.67028	1.4919	.83066	10
51	.55702	.67071	1.4910	.83050	9
52	.55726	.67113	1.4900	.83034	8
53	.55750	.67155	1.4891	.83017	7
54	.55775	.67197	1.4882	.83001	6
55	.55799	.67239	1.4872	.82985	5
56	.55823	.67282	1.4863	.82969	4
57	.55847	.67324	1.4854	.82953	3
58	.55871	.67366	1.4844	.82936	2
59	.55895	.67409	1.4835	.82920	1
60	.55919	.67451	1.4826	.82904	0
′	Cos	Cot	Tan	Sin	′

123° (303°) **(236°) 56**

′	Sin	Tan	Cot	Cos	′
34° (214°)				(325°) 145°	
0	.55919	.67451	1.4826	.82904	**60**
1	.55943	.67493	1.4816	.82887	59
2	.55968	.67536	1.4807	.82871	58
3	.55992	.67578	1.4798	.82855	57
4	.56016	.67620	1.4788	.82839	56
5	.56040	.67663	1.4779	.82822	**55**
6	.56064	.67705	1.4770	.82806	54
7	.56088	.67748	1.4761	.82790	53
8	.56112	.67790	1.4751	.82773	52
9	.56136	.67832	1.4742	.82757	51
10	.56160	.67875	1.4733	.82741	**50**
11	.56184	.67917	1.4724	.82724	49
12	.56208	.67960	1.4715	.82708	48
13	.56232	.68002	1.4705	.82692	47
14	.56256	.68045	1.4696	.82675	46
15	.56280	.68088	1.4687	.82659	**45**
16	.56305	.68130	1.4678	.82643	44
17	.56329	.68173	1.4669	.82626	43
18	.56353	.68215	1.4659	.82610	42
19	.56377	.68258	1.4650	.82593	41
20	.56401	.68301	1.4641	.82577	**40**
21	.56425	.68343	1.4632	.82561	39
22	.56449	.68386	1.4623	.82544	38
23	.56473	.68429	1.4614	.82528	37
24	.56497	.68471	1.4605	.82511	36
25	.56521	.68514	1.4596	.82495	**35**
26	.56545	.68557	1.4586	.82478	34
27	.56569	.68600	1.4577	.82462	33
28	.56593	.68642	1.4568	.82446	32
29	.56617	.68685	1.4559	.82429	31
30	.56641	.68728	1.4550	.82413	**30**
31	.56665	.68771	1.4541	.82396	29
32	.56689	.68814	1.4532	.82380	28
33	.56713	.68857	1.4523	.82363	27
34	.56736	.68900	1.4514	.82347	26
35	.56760	.68942	1.4505	.82330	**25**
36	.56784	.68985	1.4496	.82314	24
37	.56808	.69028	1.4487	.82297	23
38	.56832	.69071	1.4478	.82281	22
39	.56856	.69114	1.4469	.82264	21
40	.56880	.69157	1.4460	.82248	**20**
41	.56904	.69200	1.4451	.82231	19
42	.56928	.69243	1.4442	.82214	18
43	.56952	.69286	1.4433	.82198	17
44	.56976	.69329	1.4424	.82181	16
45	.57000	.69372	1.4415	.82165	**15**
46	.57024	.69416	1.4406	.82148	14
47	.57047	.69459	1.4397	.82132	13
48	.57071	.69502	1.4388	.82115	12
49	.57095	.69545	1.4379	.82098	11
50	.57119	.69588	1.4370	.82082	**10**
51	.57143	.69631	1.4361	.82065	9
52	.57167	.69675	1.4352	.82048	8
53	.57191	.69718	1.4344	.82032	7
54	.57215	.69761	1.4335	.82015	6
55	.57238	.69804	1.4326	.81999	**5**
56	.57262	.69847	1.4317	.81982	4
57	.57286	.69891	1.4308	.81965	3
58	.57310	.69934	1.4299	.81949	2
59	.57334	.69977	1.4290	.81932	1
60	.57358	.70021	1.4281	.81915	**0**
′	Cos	Cot	Tan	Sin	′
54° (304°)				(235°) 55°	

′	Sin	Tan	Cot	Cos	′
35° (215°)				(324°) 144°	
0	.57358	.70021	1.4281	.81915	**60**
1	.57381	.70064	1.4273	.81899	59
2	.57405	.70107	1.4264	.81882	58
3	.57429	.70151	1.4255	.81865	57
4	.57453	.70194	1.4246	.81848	56
5	.57477	.70238	1.4237	.81832	**55**
6	.57501	.70281	1.4229	.81815	54
7	.57524	.70325	1.4220	.81798	53
8	.57548	.70368	1.4211	.81782	52
9	.57572	.70412	1.4202	.81765	51
10	.57596	.70455	1.4193	.81748	**50**
11	.57619	.70499	1.4185	.81731	49
12	.57643	.70542	1.4176	.81714	48
13	.57667	.70586	1.4167	.81698	47
14	.57691	.70629	1.4158	.81681	46
15	.57715	.70673	1.4150	.81664	**45**
16	.57738	.70717	1.4141	.81647	44
17	.57762	.70760	1.4132	.81631	43
18	.57786	.70804	1.4124	.81614	42
19	.57810	.70848	1.4115	.81597	41
20	.57833	.70891	1.4106	.81580	**40**
21	.57857	.70935	1.4097	.81563	39
22	.57881	.70979	1.4089	.81546	38
23	.57904	.71023	1.4080	.81530	37
24	.57928	.71066	1.4071	.81513	36
25	.57952	.71110	1.4063	.81496	**35**
26	.57976	.71154	1.4054	.81479	34
27	.57999	.71198	1.4045	.81462	33
28	.58023	.71242	1.4037	.81445	32
29	.58047	.71285	1.4028	.81428	31
30	.58070	.71329	1.4019	.81412	**30**
31	.58094	.71373	1.4011	.81395	29
32	.58118	.71417	1.4002	.81378	28
33	.58141	.71461	1.3994	.81361	27
34	.58165	.71505	1.3985	.81344	26
35	.58189	.71549	1.3976	.81327	**25**
36	.58212	.71593	1.3968	.81310	24
37	.58236	.71637	1.3959	.81293	23
38	.58260	.71681	1.3951	.81276	22
39	.58283	.71725	1.3942	.81259	21
40	.58307	.71769	1.3934	.81242	**20**
41	.58330	.71813	1.3925	.81225	19
42	.58354	.71857	1.3916	.81208	18
43	.58378	.71901	1.3908	.81191	17
44	.58401	.71946	1.3899	.81174	16
45	.58425	.71990	1.3891	.81157	**15**
46	.58449	.72034	1.3882	.81140	14
47	.58472	.72078	1.3874	.81123	13
48	.58496	.72122	1.3865	.81106	12
49	.58519	.72167	1.3857	.81089	11
50	.58543	.72211	1.3848	.81072	**10**
51	.58567	.72255	1.3840	.81055	9
52	.58590	.72299	1.3831	.81038	8
53	.58614	.72344	1.3823	.81021	7
54	.58637	.72388	1.3814	.81004	6
55	.58661	.72432	1.3806	.80987	**5**
56	.58684	.72477	1.3798	.80970	4
57	.58708	.72521	1.3789	.80953	3
58	.58731	.72565	1.3781	.80936	2
59	.58755	.72610	1.3772	.80919	1
60	.58779	.72654	1.3764	.80902	**0**
′	Cos	Cot	Tan	Sin	′
125° (305°)				(234°) 54°	

36° (216°) (323°) **143°**

′	Sin	Tan	Cot	Cos	′
0	.58779	.72654	1.3764	.80902	**60**
1	.58802	.72699	1.3755	.80885	59
2	.58826	.72743	1.3747	.80867	58
3	.58849	.72788	1.3739	.80850	57
4	.58873	.72832	1.3730	.80833	56
5	.58896	.72877	1.3722	.80816	**55**
6	.58920	.72921	1.3713	.80799	54
7	.58943	.72966	1.3705	.80782	53
8	.58967	.73010	1.3697	.80765	52
9	.58990	.73055	1.3688	.80748	51
10	.59014	.73100	1.3680	.80730	**50**
11	.59037	.73144	1.3672	.80713	49
12	.59061	.73189	1.3663	.80696	48
13	.59084	.73234	1.3655	.80679	47
14	.59108	.73278	1.3647	.80662	46
15	.59131	.73323	1.3638	.80644	**45**
16	.59154	.73368	1.3630	.80627	44
17	.59178	.73413	1.3622	.80610	43
18	.59201	.73457	1.3613	.80593	42
19	.59225	.73502	1.3605	.80576	41
20	.59248	.73547	1.3597	.80558	**40**
21	.59272	.73592	1.3588	.80541	39
22	.59295	.73637	1.3580	.80524	38
23	.59318	.73681	1.3572	.80507	37
24	.59342	.73726	1.3564	.80489	36
25	.59365	.73771	1.3555	.80472	**35**
26	.59389	.73816	1.3547	.80455	34
27	.59412	.73861	1.3539	.80438	33
28	.59436	.73906	1.3531	.80420	32
29	.59459	.73951	1.3522	.80403	31
30	.59482	.73996	1.3514	.80386	**30**
31	.59506	.74041	1.3506	.80368	29
32	.59529	.74086	1.3498	.80351	28
33	.59552	.74131	1.3490	.80334	27
34	.59576	.74176	1.3481	.80316	26
35	.59599	.74221	1.3473	.80299	**25**
36	.59622	.74267	1.3465	.80282	24
37	.59646	.74312	1.3457	.80264	23
38	.59669	.74357	1.3449	.80247	22
39	.59693	.74402	1.3440	.80230	21
40	.59716	.74447	1.3432	.80212	**20**
41	.59739	.74492	1.3424	.80195	19
42	.59763	.74538	1.3416	.80178	18
43	.59786	.74583	1.3408	.80160	17
44	.59809	.74628	1.3400	.80143	16
45	.59832	.74674	1.3392	.80125	**15**
46	.59856	.74719	1.3384	.80108	14
47	.59879	.74764	1.3375	.80091	13
48	.59902	.74810	1.3367	.80073	12
49	.59926	.74855	1.3359	.80056	11
50	.59949	.74900	1.3351	.80038	**10**
51	.59972	.74946	1.3343	.80021	9
52	.59995	.74991	1.3335	.80003	8
53	.60019	.75037	1.3327	.79986	7
54	.60042	.75082	1.3319	.79968	6
55	.60065	.75128	1.3311	.79951	**5**
56	.60089	.75173	1.3303	.79934	4
57	.60112	.75219	1.3295	.79916	3
58	.60135	.75264	1.3287	.79899	2
59	.60158	.75310	1.3278	.79881	1
60	.60182	.75355	1.3270	.79864	**0**
′	Cos	Cot	Tan	Sin	′

126° (306°) (233°) **53°**

37° (217°) (322°) **142°**

′	Sin	Tan	Cot	Cos	′
0	.60182	.75355	1.3270	.79864	**60**
1	.60205	.75401	1.3262	.79846	59
2	.60228	.75447	1.3254	.79829	58
3	.60251	.75492	1.3246	.79811	57
4	.60274	.75538	1.3238	.79793	56
5	.60298	.75584	1.3230	.79776	**55**
6	.60321	.75629	1.3222	.79758	54
7	.60344	.75675	1.3214	.79741	53
8	.60367	.75721	1.3206	.79723	52
9	.60390	.75767	1.3198	.79706	51
10	.60414	.75812	1.3190	.79688	**50**
11	.60437	.75858	1.3182	.79671	49
12	.60460	.75904	1.3175	.79653	48
13	.60483	.75950	1.3167	.79635	47
14	.60506	.75996	1.3159	.79618	46
15	.60529	.76042	1.3151	.79600	**45**
16	.60553	.76088	1.3143	.79583	44
17	.60576	.76134	1.3135	.79565	43
18	.60599	.76180	1.3127	.79547	42
19	.60622	.76226	1.3119	.79530	41
20	.60645	.76272	1.3111	.79512	**40**
21	.60668	.76318	1.3103	.79494	39
22	.60691	.76364	1.3095	.79477	38
23	.60714	.76410	1.3087	.79459	37
24	.60738	.76456	1.3079	.79441	36
25	.60761	.76502	1.3072	.79424	**35**
26	.60784	.76548	1.3064	.79406	34
27	.60807	.76594	1.3056	.79388	33
28	.60830	.76640	1.3048	.79371	32
29	.60853	.76686	1.3040	.79353	31
30	.60876	.76733	1.3032	.79335	**30**
31	.60899	.76779	1.3024	.79318	29
32	.60922	.76825	1.3017	.79300	28
33	.60945	.76871	1.3009	.79282	27
34	.60968	.76918	1.3001	.79264	26
35	.60991	.76964	1.2993	.79247	**25**
36	.61015	.77010	1.2985	.79229	24
37	.61038	.77057	1.2977	.79211	23
38	.61061	.77103	1.2970	.79193	22
39	.61084	.77149	1.2962	.79176	21
40	.61107	.77196	1.2954	.79158	**20**
41	.61130	.77242	1.2946	.79140	19
42	.61153	.77289	1.2938	.79122	18
43	.61176	.77335	1.2931	.79105	17
44	.61199	.77382	1.2923	.79087	16
45	.61222	.77428	1.2915	.79069	**15**
46	.61245	.77475	1.2907	.79051	14
47	.61268	.77521	1.2900	.79033	13
48	.61291	.77568	1.2892	.79016	12
49	.61314	.77615	1.2884	.78998	11
50	.61337	.77661	1.2876	.78980	**10**
51	.61360	.77708	1.2869	.78962	9
52	.61383	.77754	1.2861	.78944	8
53	.61406	.77801	1.2853	.78926	7
54	.61429	.77848	1.2846	.78908	6
55	.61451	.77895	1.2838	.78891	**5**
56	.61474	.77941	1.2830	.78873	4
57	.61497	.77988	1.2822	.78855	3
58	.61520	.78035	1.2815	.78837	2
59	.61543	.78082	1.2807	.78819	1
60	.61566	.78129	1.2799	.78801	**0**
′	Cos	Cot	Tan	Sin	′

127° (307°) (232°) **52°**

38° (218°) (321°) **141°**

′	Sin	Tan	Cot	Cos	′
0	.61566	.78129	1.2799	.78801	**60**
1	.61589	.78175	1.2792	.78783	59
2	.61612	.78222	1.2784	.78765	58
3	.61635	.78269	1.2776	.78747	57
4	.61658	.78316	1.2769	.78729	56
5	.61681	.78363	1.2761	.78711	**55**
6	.61704	.78410	1.2753	.78694	54
7	.61726	.78457	1.2746	.78676	53
8	.61749	.78504	1.2738	.78658	52
9	.61772	.78551	1.2731	.78640	51
10	.61795	.78598	1.2723	.78622	**50**
11	.61818	.78645	1.2715	.78604	49
12	.61841	.78692	1.2708	.78586	48
13	.61864	.78739	1.2700	.78568	47
14	.61887	.78786	1.2693	.78550	46
15	.61909	.78834	1.2685	.78532	**45**
16	.61932	.78881	1.2677	.78514	44
17	.61955	.78928	1.2670	.78496	43
18	.61978	.78975	1.2662	.78478	42
19	.62001	.79022	1.2655	.78460	41
20	.62024	.79070	1.2647	.78442	**40**
21	.62046	.79117	1.2640	.78424	39
22	.62069	.79164	1.2632	.78405	38
23	.62092	.79212	1.2624	.78387	37
24	.62115	.79259	1.2617	.78369	36
25	.62138	.79306	1.2609	.78351	**35**
26	.62160	.79354	1.2602	.78333	34
27	.62183	.79401	1.2594	.78315	33
28	.62206	.79449	1.2587	.78297	32
29	.62229	.79496	1.2579	.78279	31
30	.62251	.79544	1.2572	.78261	**30**
31	.62274	.79591	1.2564	.78243	29
32	.62297	.79639	1.2557	.78225	28
33	.62320	.79686	1.2549	.78206	27
34	.62342	.79734	1.2542	.78188	26
35	.62365	.79781	1.2534	.78170	**25**
36	.62388	.79829	1.2527	.78152	24
37	.62411	.79877	1.2519	.78134	23
38	.62433	.79924	1.2512	.78116	22
39	.62456	.79972	1.2504	.78098	21
40	.62479	.80020	1.2497	.78079	**20**
41	.62502	.80067	1.2489	.78061	19
42	.62524	.80115	1.2482	.78043	18
43	.62547	.80163	1.2475	.78025	17
44	.62570	.80211	1.2467	.78007	16
45	.62592	.80258	1.2460	.77988	**15**
46	.62615	.80306	1.2452	.77970	14
47	.62638	.80354	1.2445	.77952	13
48	.62660	.80402	1.2437	.77934	12
49	.62683	.80450	1.2430	.77916	11
50	.62706	.80498	1.2423	.77897	**10**
51	.62728	.80546	1.2415	.77879	9
52	.62751	.80594	1.2408	.77861	8
53	.62774	.80642	1.2401	.77843	7
54	.62796	.80690	1.2393	.77824	6
55	.62819	.80738	1.2386	.77806	**5**
56	.62842	.80786	1.2378	.77788	4
57	.62864	.80834	1.2371	.77769	3
58	.62887	.80882	1.2364	.77751	2
59	.62909	.80930	1.2356	.77733	1
60	.62932	.80978	1.2349	.77715	**0**
′	Cos	Cot	Tan	Sin	′

28° (308°) (231°) **51°**

39° (219°) (320°) **140°**

′	Sin	Tan	Cot	Cos	′
0	.62932	.80978	1.2349	.77715	**60**
1	.62955	.81027	1.2342	.77696	59
2	.62977	.81075	1.2334	.77678	58
3	.63000	.81123	1.2327	.77660	57
4	.63022	.81171	1.2320	.77641	56
5	.63045	.81220	1.2312	.77623	**55**
6	.63068	.81268	1.2305	.77605	54
7	.63090	.81316	1.2298	.77586	53
8	.63113	.81364	1.2290	.77568	52
9	.63135	.81413	1.2283	.77550	51
10	.63158	.81461	1.2276	.77531	**50**
11	.63180	.81510	1.2268	.77513	49
12	.63203	.81558	1.2261	.77494	48
13	.63225	.81606	1.2254	.77476	47
14	.63248	.81655	1.2247	.77458	46
15	.63271	.81703	1.2239	.77439	**45**
16	.63293	.81752	1.2232	.77421	44
17	.63316	.81800	1.2225	.77402	43
18	.63338	.81849	1.2218	.77384	42
19	.63361	.81898	1.2210	.77366	41
20	.63383	.81946	1.2203	.77347	**40**
21	.63406	.81995	1.2196	.77329	39
22	.63428	.82044	1.2189	.77310	38
23	.63451	.82092	1.2181	.77292	37
24	.63473	.82141	1.2174	.77273	36
25	.63496	.82190	1.2167	.77255	**35**
26	.63518	.82238	1.2160	.77236	34
27	.63540	.82287	1.2153	.77218	33
28	.63563	.82336	1.2145	.77199	32
29	.63585	.82385	1.2138	.77181	31
30	.63608	.82434	1.2131	.77162	**30**
31	.63630	.82483	1.2124	.77144	29
32	.63653	.82531	1.2117	.77125	28
33	.63675	.82580	1.2109	.77107	27
34	.63698	.82629	1.2102	.77088	26
35	.63720	.82678	1.2095	.77070	**25**
36	.63742	.82727	1.2088	.77051	24
37	.63765	.82776	1.2081	.77033	23
38	.63787	.82825	1.2074	.77014	22
39	.63810	.82874	1.2066	.76996	21
40	.63832	.82923	1.2059	.76977	**20**
41	.63854	.82972	1.2052	.76959	19
42	.63877	.83022	1.2045	.76940	18
43	.63899	.83071	1.2038	.76921	17
44	.63922	.83120	1.2031	.76903	16
45	.63944	.83169	1.2024	.76884	**15**
46	.63966	.83218	1.2017	.76866	14
47	.63989	.83268	1.2009	.76847	13
48	.64011	.83317	1.2002	.76828	12
49	.64033	.83366	1.1995	.76810	11
50	.64056	.83415	1.1988	.76791	**10**
51	.64078	.83465	1.1981	.76772	9
52	.64100	.83514	1.1974	.76754	8
53	.64123	.83564	1.1967	.76735	7
54	.64145	.83613	1.1960	.76717	6
55	.64167	.83662	1.1953	.76698	**5**
56	.64190	.83712	1.1946	.76679	4
57	.64212	.83761	1.1939	.76661	3
58	.64234	.83811	1.1932	.76642	2
59	.64256	.83860	1.1925	.76623	1
60	.64279	.83910	1.1918	.76604	**0**
′	Cos	Cot	Tan	Sin	′

129° (309°) (230°) **50°**

40° (220°) (319°) **139°**

′	Sin	Tan	Cot	Cos	′
0	.64279	.83910	1.1918	.76604	**60**
1	.64301	.83960	1.1910	.76586	59
2	.64323	.84009	1.1903	.76567	58
3	.64346	.84059	1.1896	.76548	57
4	.64368	.84108	1.1889	.76530	56
5	.64390	.84158	1.1882	.76511	**55**
6	.64412	.84208	1.1875	.76492	54
7	.64435	.84258	1.1868	.76473	53
8	.64457	.84307	1.1861	.76455	52
9	.64479	.84357	1.1854	.76436	51
10	.64501	.84407	1.1847	.76417	**50**
11	.64524	.84457	1.1840	.76398	49
12	.64546	.84507	1.1833	.76380	48
13	.64568	.84556	1.1826	.76361	47
14	.64590	.84606	1.1819	.76342	46
15	.64612	.84656	1.1812	.76323	**45**
16	.64635	.84706	1.1806	.76304	44
17	.64657	.84756	1.1799	.76286	43
18	.64679	.84806	1.1792	.76267	42
19	.64701	.84856	1.1785	.76248	41
20	.64723	.84906	1.1778	.76229	**40**
21	.64746	.84956	1.1771	.76210	39
22	.64768	.85006	1.1764	.76192	38
23	.64790	.85057	1.1757	.76173	37
24	.64812	.85107	1.1750	.76154	36
25	.64834	.85157	1.1743	.76135	**35**
26	.64856	.85207	1.1736	.76116	34
27	.64878	.85257	1.1729	.76097	33
28	.64901	.85308	1.1722	.76078	32
29	.64923	.85358	1.1715	.76059	31
30	.64945	.85408	1.1708	.76041	**30**
31	.64967	.85458	1.1702	.76022	29
32	.64989	.85509	1.1695	.76003	28
33	.65011	.85559	1.1688	.75984	27
34	.65033	.85609	1.1681	.75965	26
35	.65055	.85660	1.1674	.75946	**25**
36	.65077	.85710	1.1667	.75927	24
37	.65100	.85761	1.1660	.75908	23
38	.65122	.85811	1.1653	.75889	22
39	.65144	.85862	1.1647	.75870	21
40	.65166	.85912	1.1640	.75851	**20**
41	.65188	.85963	1.1633	.75832	19
42	.65210	.86014	1.1626	.75813	18
43	.65232	.86064	1.1619	.75794	17
44	.65254	.86115	1.1612	.75775	16
45	.65276	.86166	1.1606	.75756	**15**
46	.65298	.86216	1.1599	.75738	14
47	.65320	.86267	1.1592	.75719	13
48	.65342	.86318	1.1585	.75700	12
49	.65364	.86368	1.1578	.75680	11
50	.65386	.86419	1.1571	.75661	**10**
51	.65408	.86470	1.1565	.75642	9
52	.65430	.86521	1.1558	.75623	8
53	.65452	.86572	1.1551	.75604	7
54	.65474	.86623	1.1544	.75585	6
55	.65496	.86674	1.1538	.75566	**5**
56	.65518	.86725	1.1531	.75547	4
57	.65540	.86776	1.1524	.75528	3
58	.65562	.86827	1.1517	.75509	2
59	.65584	.86878	1.1510	.75490	1
60	.65606	.86929	1.1504	.75471	**0**
′	Cos	Cot	Tan	Sin	′

130° (310°) (229°) **49°**

41° (221°) (318°) **138°**

′	Sin	Tan	Cot	Cos	′
0	.65606	.86929	1.1504	.75471	**60**
1	.65628	.86980	1.1497	.75452	59
2	.65650	.87031	1.1490	.75433	58
3	.65672	.87082	1.1483	.75414	57
4	.65694	.87133	1.1477	.75395	56
5	.65716	.87184	1.1470	.75375	**55**
6	.65738	.87236	1.1463	.75356	54
7	.65759	.87287	1.1456	.75337	53
8	.65781	.87338	1.1450	.75318	52
9	.65803	.87389	1.1443	.75299	51
10	.65825	.87441	1.1436	.75280	**50**
11	.65847	.87492	1.1430	.75261	49
12	.65869	.87543	1.1423	.75241	48
13	.65891	.87595	1.1416	.75222	47
14	.65913	.87646	1.1410	.75203	46
15	.65935	.87698	1.1403	.75184	**45**
16	.65956	.87749	1.1396	.75165	44
17	.65978	.87801	1.1389	.75146	43
18	.66000	.87852	1.1383	.75126	42
19	.66022	.87904	1.1376	.75107	41
20	.66044	.87955	1.1369	.75088	**40**
21	.66066	.88007	1.1363	.75069	39
22	.66088	.88059	1.1356	.75050	38
23	.66109	.88110	1.1349	.75030	37
24	.66131	.88162	1.1343	.75011	36
25	.66153	.88214	1.1336	.74992	**35**
26	.66175	.88265	1.1329	.74973	34
27	.66197	.88317	1.1323	.74953	33
28	.66218	.88369	1.1316	.74934	32
29	.66240	.88421	1.1310	.74915	31
30	.66262	.88473	1.1303	.74896	**30**
31	.66284	.88524	1.1296	.74876	29
32	.66306	.88576	1.1290	.74857	28
33	.66327	.88628	1.1283	.74838	27
34	.66349	.88680	1.1276	.74818	26
35	.66371	.88732	1.1270	.74799	**25**
36	.66393	.88784	1.1263	.74780	24
37	.66414	.88836	1.1257	.74760	23
38	.66436	.88888	1.1250	.74741	22
39	.66458	.88940	1.1243	.74722	21
40	.66480	.88992	1.1237	.74703	**20**
41	.66501	.89045	1.1230	.74683	19
42	.66523	.89097	1.1224	.74664	18
43	.66545	.89149	1.1217	.74644	17
44	.66566	.89201	1.1211	.74625	16
45	.66588	.89253	1.1204	.74606	**15**
46	.66610	.89306	1.1197	.74586	14
47	.66632	.89358	1.1191	.74567	13
48	.66653	.89410	1.1184	.74548	12
49	.66675	.89463	1.1178	.74528	11
50	.66697	.89515	1.1171	.74509	**10**
51	.66718	.89567	1.1165	.74489	9
52	.66740	.89620	1.1158	.74470	8
53	.66762	.89672	1.1152	.74451	7
54	.66783	.89725	1.1145	.74431	6
55	.66805	.89777	1.1139	.74412	**5**
56	.66827	.89830	1.1132	.74392	4
57	.66848	.89883	1.1126	.74373	3
58	.66870	.89935	1.1119	.74353	2
59	.66891	.89988	1.1113	.74334	1
60	.66913	.90040	1.1106	.74314	**0**
′	Cos	Cot	Tan	Sin	′

131° (311°) (228°) **48°**

′	Sin	Tan	Cot	Cos	′
0	.66913	.90040	1.1106	.74314	**60**
1	.66935	.90093	1.1100	.74295	59
2	.66956	.90146	1.1093	.74276	58
3	.66978	.90199	1.1087	.74256	57
4	.66999	.90251	1.1080	.74237	56
5	.67021	.90304	1.1074	.74217	**55**
6	.67043	.90357	1.1067	.74198	54
7	.67064	.90410	1.1061	.74178	53
8	.67086	.90463	1.1054	.74159	52
9	.67107	.90516	1.1048	.74139	51
10	.67129	.90569	1.1041	.74120	**50**
11	.67151	.90621	1.1035	.74100	49
12	.67172	.90674	1.1028	.74080	48
13	.67194	.90727	1.1022	.74061	47
14	.67215	.90781	1.1016	.74041	46
15	.67237	.90834	1.1009	.74022	**45**
16	.67258	.90887	1.1003	.74002	44
17	.67280	.90940	1.0996	.73983	43
18	.67301	.90993	1.0990	.73963	42
19	.67323	.91046	1.0983	.73944	41
20	.67344	.91099	1.0977	.73924	**40**
21	.67366	.91153	1.0971	.73904	39
22	.67387	.91206	1.0964	.73885	38
23	.67409	.91259	1.0958	.73865	37
24	.67430	.91313	1.0951	.73846	36
25	.67452	.91366	1.0945	.73826	**35**
26	.67473	.91419	1.0939	.73806	34
27	.67495	.91473	1.0932	.73787	33
28	.67516	.91526	1.0926	.73767	32
29	.67538	.91580	1.0919	.73747	31
30	.67559	.91633	1.0913	.73728	**30**
31	.67580	.91687	1.0907	.73708	29
32	.67602	.91740	1.0900	.73688	28
33	.67623	.91794	1.0894	.73669	27
34	.67645	.91847	1.0888	.73649	26
35	.67666	.91901	1.0881	.73629	**25**
36	.67688	.91955	1.0875	.73610	24
37	.67709	.92008	1.0869	.73590	23
38	.67730	.92062	1.0862	.73570	22
39	.67752	.92116	1.0856	.73551	21
40	.67773	.92170	1.0850	.73531	**20**
41	.67795	.92224	1.0843	.73511	19
42	.67816	.92277	1.0837	.73491	18
43	.67837	.92331	1.0831	.73472	17
44	.67859	.92385	1.0824	.73452	16
45	.67880	.92439	1.0818	.73432	**15**
46	.67901	.92493	1.0812	.73413	14
47	.67923	.92547	1.0805	.73393	13
48	.67944	.92601	1.0799	.73373	12
49	.67965	.92655	1.0793	.73353	11
50	.67987	.92709	1.0786	.73333	**10**
51	.68008	.92763	1.0780	.73314	9
52	.68029	.92817	1.0774	.73294	8
53	.68051	.92872	1.0768	.73274	7
54	.68072	.92926	1.0761	.73254	6
55	.68093	.92980	1.0755	.73234	**5**
56	.68115	.93034	1.0749	.73215	4
57	.68136	.93088	1.0742	.73195	3
58	.68157	.93143	1.0736	.73175	2
59	.68179	.93197	1.0730	.73155	1
60	.68200	.93252	1.0724	.73135	**0**
′	Cos	Cot	Tan	Sin	′

′	Sin	Tan	Cot	Cos	′
0	.68200	.93252	1.0724	.73135	**60**
1	.68221	.93306	1.0717	.73116	59
2	.68242	.93360	1.0711	.73096	58
3	.68264	.93415	1.0705	.73076	57
4	.68285	.93469	1.0699	.73056	56
5	.68306	.93524	1.0692	.73036	**55**
6	.68327	.93578	1.0686	.73016	54
7	.68349	.93633	1.0680	.72996	53
8	.68370	.93688	1.0674	.72976	52
9	.68391	.93742	1.0668	.72957	51
10	.68412	.93797	1.0661	.72937	**50**
11	.68434	.93852	1.0655	.72917	49
12	.68455	.93906	1.0649	.72897	48
13	.68476	.93961	1.0643	.72877	47
14	.68497	.94016	1.0637	.72857	46
15	.68518	.94071	1.0630	.72837	**45**
16	.68539	.94125	1.0624	.72817	44
17	.68561	.94180	1.0618	.72797	43
18	.68582	.94235	1.0612	.72777	42
19	.68603	.94290	1.0606	.72757	41
20	.68624	.94345	1.0599	.72737	**40**
21	.68645	.94400	1.0593	.72717	39
22	.68666	.94455	1.0587	.72697	38
23	.68688	.94510	1.0581	.72677	37
24	.68709	.94565	1.0575	.72657	36
25	.68730	.94620	1.0569	.72637	**35**
26	.68751	.94676	1.0562	.72617	34
27	.68772	.94731	1.0556	.72597	33
28	.68793	.94786	1.0550	.72577	32
29	.68814	.94841	1.0544	.72557	31
30	.68835	.94896	1.0538	.72537	**30**
31	.68857	.94952	1.0532	.72517	29
32	.68878	.95007	1.0526	.72497	28
33	.68899	.95062	1.0519	.72477	27
34	.68920	.95118	1.0513	.72457	26
35	.68941	.95173	1.0507	.72437	**25**
36	.68962	.95229	1.0501	.72417	24
37	.68983	.95284	1.0495	.72397	23
38	.69004	.95340	1.0489	.72377	22
39	.69025	.95395	1.0483	.72357	21
40	.69046	.95451	1.0477	.72337	**20**
41	.69067	.95506	1.0470	.72317	19
42	.69088	.95562	1.0464	.72297	18
43	.69109	.95618	1.0458	.72277	17
44	.69130	.95673	1.0452	.72257	16
45	.69151	.95729	1.0446	.72236	**15**
46	.69172	.95785	1.0440	.72216	14
47	.69193	.95841	1.0434	.72196	13
48	.69214	.95897	1.0428	.72176	12
49	.69235	.95952	1.0422	.72156	11
50	.69256	.96008	1.0416	.72136	**10**
51	.69277	.96064	1.0410	.72116	9
52	.69298	.96120	1.0404	.72095	8
53	.69319	.96176	1.0398	.72075	7
54	.69340	.96232	1.0392	.72055	6
55	.69361	.96288	1.0385	.72035	**5**
56	.69382	.96344	1.0379	.72015	4
57	.69403	.96400	1.0373	.71995	3
58	.69424	.96457	1.0367	.71974	2
59	.69445	.96513	1.0361	.71954	1
60	.69466	.96569	1.0355	.71934	**0**
′	Cos	Cot	Tan	Sin	′

44° (224°) (315°) **135°**

′	Sin	Tan	Cot	Cos	′
0	.69466	.96569	1.0355	.71934	**60**
1	.69487	.96625	1.0349	.71914	59
2	.69508	.96681	1.0343	.71894	58
3	.69529	.96738	1.0337	.71873	57
4	.69549	.96794	1.0331	.71853	56
5	.69570	.96850	1.0325	.71833	**55**
6	.69591	.96907	1.0319	.71813	54
7	.69612	.96963	1.0313	.71792	53
8	.69633	.97020	1.0307	.71772	52
9	.69654	.97076	1.0301	.71752	51
10	.69675	.97133	1.0295	.71732	**50**
11	.69696	.97189	1.0289	.71711	49
12	.69717	.97246	1.0283	.71691	48
13	.69737	.97302	1.0277	.71671	47
14	.69758	.97359	1.0271	.71650	46
15	.69779	.97416	1.0265	.71630	**45**
16	.69800	.97472	1.0259	.71610	44
17	.69821	.97529	1.0253	.71590	43
18	.69842	.97586	1.0247	.71569	42
19	.69862	.97643	1.0241	.71549	41
20	.69883	.97700	1.0235	.71529	**40**
21	.69904	.97756	1.0230	.71508	39
22	.69925	.97813	1.0224	.71488	38
23	.69946	.97870	1.0218	.71468	37
24	.69966	.97927	1.0212	.71447	36
25	.69987	.97984	1.0206	.71427	**35**
26	.70008	.98041	1.0200	.71407	34
27	.70029	.98098	1.0194	.71386	33
28	.70049	.98155	1.0188	.71366	32
29	.70070	.98213	1.0182	.71345	31
30	.70091	.98270	1.0176	.71325	**30**
31	.70112	.98327	1.0170	.71305	29
32	.70132	.98384	1.0164	.71284	28
33	.70153	.98441	1.0158	.71264	27
34	.70174	.98499	1.0152	.71243	26
35	.70195	.98556	1.0147	.71223	**25**
36	.70215	.98613	1.0141	.71203	24
37	.70236	.98671	1.0135	.71182	23
38	.70257	.98728	1.0129	.71162	22
39	.70277	.98786	1.0123	.71141	21
40	.70298	.98843	1.0117	.71121	**20**
41	.70319	.98901	1.0111	.71100	19
42	.70339	.98958	1.0105	.71080	18
43	.70360	.99016	1.0099	.71059	17
44	.70381	.99073	1.0094	.71039	16
45	.70401	.99131	1.0088	.71019	**15**
46	.70422	.99189	1.0082	.70998	14
47	.70443	.99247	1.0076	.70978	13
48	.70463	.99304	1.0070	.70957	12
49	.70484	.99362	1.0064	.70937	11
50	.70505	.99420	1.0058	.70916	**10**
51	.70525	.99478	1.0052	.70896	9
52	.70546	.99536	1.0047	.70875	8
53	.70567	.99594	1.0041	.70855	7
54	.70587	.99652	1.0035	.70834	6
55	.70608	.99710	1.0029	.70813	**5**
56	.70628	.99768	1.0023	.70793	4
57	.70649	.99826	1.0017	.70772	3
58	.70670	.99884	1.0012	.70752	2
59	.70690	.99942	1.0006	.70731	1
60	.70711	1.0000	1.0000	.70711	**0**
′	Cos	Cot	Tan	Sin	′

134° (314°) (225°) **45°**

NATURAL LOGARITHMS

NATURAL OR NAPERIAN LOGARITHMS OF THE NUMBERS FROM 1 TO 1109

To find the logarithm of a number which is $\frac{1}{10}$ or 10 times etc. a number whose logarithm is given, subtract from or add to the given logarithm the logarithm of 10.

Thus $\log 1.6 = \log 16 - \log 10$
$\log 160 = \log 16 + \log 10$ etc.

N	Log	N	Log	N	Log	N	Log	N	Log
0	—	**20**	2. 99 573	**40**	3. 68 888	**60**	4. 09 434	**80**	4. 38 203
1	0. 00 000	21	3. 04 452	41	3. 71 357	61	4. 11 087	81	4. 39 445
2	0. 69 315	22	3. 09 104	42	3. 73 767	62	4. 12 713	82	4. 40 672
3	1. 09 861	23	3. 13 459	43	3. 76 120	63	4. 14 313	83	4. 41 884
4	1. 38 629	24	3. 17 805	44	3. 78 419	64	4. 15 888	84	4. 43 082
5	1. 60 944	25	3. 21 888	45	3. 80 666	65	4. 17 439	85	4. 44 265
6	1. 79 176	26	3. 25 810	46	3. 82 864	66	4. 18 965	86	4. 45 435
7	1. 94 591	27	3. 29 584	47	3. 85 015	67	4. 20 469	87	4. 46 591
8	2. 07 944	28	3. 33 220	48	3. 87 120	68	4. 21 951	88	4. 47 734
9	2. 19 722	29	3. 36 730	49	3. 89 182	69	4. 23 411	89	4. 48 864
10	2. 30 259	**30**	3. 40 120	**50**	3. 91 202	**70**	4. 24 850	**90**	4. 49 981
11	2. 39 790	31	3. 43 399	51	3. 93 183	71	4. 26 268	91	4. 51 086
12	2. 48 491	32	3. 46 574	52	3. 95 124	72	4. 27 667	92	4. 52 179
13	2. 56 495	33	3. 49 651	53	3. 97 029	73	4. 29 046	93	4. 53 260
14	2. 63 906	34	3. 52 636	54	3. 98 898	74	4. 30 407	94	4. 54 329
15	2. 70 805	35	3. 55 535	55	4. 00 733	75	4. 31 749	95	4. 55 388
16	2. 77 259	36	3. 58 352	56	4. 02 535	76	4. 33 073	96	4. 56 435
17	2. 83 321	37	3. 61 092	57	4. 04 305	77	4. 34 381	97	4. 57 471
18	2. 89 037	38	3. 63 759	58	4. 06 044	78	4. 35 671	98	4. 58 497
19	2. 94 444	39	3. 66 356	59	4. 07 754	79	4. 36 945	99	4. 59 512
20	2. 99 573	**40**	3. 68 888	**60**	4. 09 434	**80**	4. 38 203	**100**	4. 60 517

NATURAL LOGARITHMS (Continued)

N	Log 0	1	2	3	4	5	6	7	8	9
10	4. 6 0517	1512	2497	3473	4439	5396	6344	7283	8213	9135
11	4. 7 0048	0953	1850	2739	3620	4493	5359	6217	7068	7912
12	8749	9579	*0402	*1218	*2028	*2831	*3628	*4419	*5203	*5981
13	4. 8 6753	7520	8280	9035	9784	*0527	*1265	*1998	*2725	*3447
14	4. 9 4164	4876	5583	6284	6981	7673	8361	9043	9721	*0395
15	5. 0 1064	1728	2388	3044	3695	4343	4986	5625	6260	6890
16	7517	8140	8760	9375	9987	*0595	*1199	*1799	*2396	*2990
17	5. 1 3580	4166	4749	5329	5906	6479	7048	7615	8178	8739
18	9296	9850	*0401	*0949	*1494	*2036	*2575	*3111	*3644	*4175
19	5. 2 4702	5227	5750	6269	6786	7300	7811	8320	8827	9330
20	9832	*0330	*0827	*1321	*1812	*2301	*2788	*3272	*3754	*4233
21	5. 3 4711	5186	5659	6129	6598	7064	7528	7990	8450	8907
22	9363	9816	*0268	*0717	*1165	*1610	*2053	*2495	*2935	*3372
23	5. 4 3808	4242	4674	5104	5532	5959	6383	6806	7227	7646
24	8064	8480	8894	9306	9717	*0126	*0533	*0939	*1343	*1745
25	5. 5 2146	2545	2943	3339	3733	4126	4518	4908	5296	5683
26	6068	6452	6834	7215	7595	7973	8350	8725	9099	9471
27	9842	*0212	*0580	*0947	*1313	*1677	*2040	*2402	*2762	*3121
28	5. 6 3479	3835	4191	4545	4897	5249	5599	5948	6296	6643
29	6988	7332	7675	8017	8358	8698	9036	9373	9709	*0044
30	5. 7 0378	0711	1043	1373	1703	2031	2359	2685	3010	3334
31	3657	3979	4300	4620	4939	5257	5574	5890	6205	6519
32	6832	7144	7455	7765	8074	8383	8690	8996	9301	9606
33	9909	*0212	*0513	*0814	*1114	*1413	*1711	*2008	*2305	*2600
34	5. 8 2895	3188	3481	3773	4064	4354	4644	4932	5220	5507
35	5793	6079	6363	6647	6930	7212	7493	7774	8053	8332
36	8610	8888	9164	9440	9715	9990	*0263	*0536	*0808	*1080
37	5. 9 1350	1620	1889	2158	2426	2693	2959	3225	3489	3754
38	4017	4280	4542	4803	5064	5324	5584	5842	6101	6358
39	6615	6871	7126	7381	7635	7889	8141	8394	8645	8899
40	9146	9396	9645	9894	*0141	*0389	*0635	*0881	*1127	*1372
41	6. 0 1616	1859	2102	2345	2587	2828	3069	3309	3548	3787
42	4025	4263	4501	4737	4973	5209	5444	5678	5912	6146
43	6379	6611	6843	7074	7304	7535	7764	7993	8222	8450
44	8677	8904	9131	9357	9582	9807	*0032	*0256	*0479	*0702
45	6. 1 0925	1147	1368	1589	1810	2030	2249	2468	2687	2905
46	3123	3340	3556	3773	3988	4204	4419	4633	4847	5060
47	5273	5486	5698	5910	6121	6331	6542	6752	6961	7170
48	7379	7587	7794	8002	8208	8415	8621	8826	9032	9236
49	9441	9644	9848	*0051	*0254	*0456	*0658	*0859	*1060	*1261
50	6. 2 1461	1661	1860	2059	2258	2456	2654	2851	3048	3245
51	3441	3637	3832	4028	4222	4417	4611	4804	4998	5190
52	5383	5575	5767	5958	6149	6340	6530	6720	6910	7099
53	7288	7476	7664	7852	8040	8227	8413	8600	8786	8972
54	9157	9342	9527	9711	9895	*0079	*0262	*0445	*0628	*0810
55	6. 3 0992	1173	1355	1536	1716	1897	2077	2257	2436	2615
56	2794	2972	3150	3328	3505	3683	3859	4036	4212	4388
57	4564	4739	4914	5089	5263	5437	5611	5784	5957	6130
58	6303	6475	6647	6819	6990	7161	7332	7502	7673	7843
59	8012	8182	8351	8519	8688	8856	9024	9192	9359	9526
60	9693	9859	*0026	*0192	*0357	*0523	*0688	*0853	*1017	*1182

N	Log 0	1	2	3	4	5	6	7	8	9

NATURAL LOGARITHMS (Continued)

N	Log	0	1	2	3	4	5	6	7	8	9
60	6. 3	9693	9859	*0026	*0192	*0357	*0523	*0688	*0853	*1017	*1182
61	6. 4	1346	1510	1673	1836	1999	2162	2325	2487	2649	2811
62		2972	3133	3294	3455	3615	3775	3935	4095	4254	4413
63		4572	4731	4889	5047	5205	5362	5520	5677	5834	5990
64		6147	6303	6459	6614	6770	6925	7080	7235	7389	7543
65		7697	7851	8004	8158	8311	8464	8616	8768	8920	9072
66		9224	9375	9527	9677	9828	9979	*0129	*0279	*0429	*0578
67	6. 5	0728	0877	1026	1175	1323	1471	1619	1767	1915	2062
68		2209	2356	2503	2649	2796	2942	3088	3233	3379	3524
69		3669	3814	3959	4103	4247	4391	4535	4679	4822	4965
70		5108	5251	5393	5536	5678	5820	5962	6103	6244	6386
71		6526	6667	6808	6948	7088	7228	7368	7508	7647	7786
72		7925	8064	8203	8341	8479	8617	8755	8893	9030	9167
73		9304	9441	9578	9715	9851	9987	*0123	*0259	*0394	*0530
74	6. 6	0665	0800	0935	1070	1204	1338	1473	1607	1740	1874
75		2007	2141	2274	2407	2539	2672	2804	2936	3068	3200
76		3332	3463	3595	3726	3857	3988	4118	4249	4379	4509
77		4639	4769	4898	5028	5157	5286	5415	5544	5673	5801
78		5929	6058	6185	6313	6441	6568	6696	6823	6950	7077
79		7203	7330	7456	7582	7870	7834	7960	8085	8211	8336
80		8461	8586	8711	8835	8960	9084	9208	9332	9456	9580
81		9703	9827	9950	*0073	*0196	*0319	*0441	*0564	*0686	*0808
82	6. 7	0930	1052	1174	1296	1417	1538	1659	1780	1901	2022
83		2143	2263	2383	2503	2623	2743	2863	2982	3102	3221
84		3340	3459	3578	3697	3815	3934	4052	4170	4288	4406
85		4524	4641	4759	4876	4993	5110	5227	5344	5460	5577
86		5693	5809	5926	6041	6157	6273	6388	6504	6619	6734
87		6849	6964	7079	7194	7308	7422	7537	7651	7765	7878
88		7992	8106	8219	8333	8446	8559	8672	8784	8897	9010
89		9122	9234	9347	9459	9571	9682	9794	9906	*0017	*0128
90	6. 8	0239	0351	0461	0572	0683	0793	0904	1014	1124	1235
91		1344	1454	1564	1674	1783	1892	2002	2111	2220	2329
92		2437	2546	2655	2763	2871	2979	3087	3195	3303	3411
93		3518	3626	3733	3841	3948	4055	4162	4268	4375	4482
94		4588	4694	4801	4907	5013	5118	5224	5330	5435	5541
95		5646	5751	5857	5961	6066	6171	6276	6380	6485	6589
96		6693	6797	6901	7005	7109	7213	7316	7420	7523	7626
97		7730	7833	7936	8038	8141	8244	8346	8449	8551	8653
98		8755	8857	8959	9061	9163	9264	9366	9467	9568	9669
99		9770	9871	9972	*0073	*0174	*0274	*0375	*0475	*0575	*0675
100	6. 9	0776	0875	0975	1075	1175	1274	1374	1473	1572	1672
101		1771	1870	1968	2067	2166	2264	2363	2461	2560	2658
102		2756	2854	2952	3049	3147	3245	3342	3440	3537	3634
103		3731	3828	3925	4022	4119	4216	4312	4409	4505	4601
104		4698	4794	4890	4986	5081	5177	5273	5368	5464	5559
105		5655	5750	5845	5940	6035	6130	6224	6319	6414	6508
106		6602	6697	6791	6885	6979	7073	7167	7261	7354	7448
107		7541	7635	7728	7821	7915	8008	8101	8193	8286	8379
108		8472	8564	8657	8749	8841	8934	9026	9118	9210	9302
109		9393	9485	9577	9668	9760	9851	9942	*0033	*0125	*0216
110	7. 0	0307	0397	0488	0579	0670	0760	0851	0941	1031	1121

N	Log	0	1	2	3	4	5	6	7	8	9

EXPONENTIALS

This table gives the values of e^n for the values of n shown at the side and top.

	0.00	0.01	0.02	0 03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	1.000	1.010	1.020	1.030	1.041	1.051	1.062	1.073	1.083	1.094
0.1	1.105	1.116	1.127	1.139	1.150	1.162	1.174	1.185	1.197	1.209
0.2	1.221	1.234	1.246	1.259	1.271	1.284	1.297	1.310	1.323	1.336
0.3	1.350	1.363	1.377	1.391	1.405	1.419	1.433	1.448	1.462	1.477
0.4	1.492	1.507	1.522	1.537	1.553	1.568	1.584	1.600	1.616	1.632
0.5	1.649	1.665	1.682	1.699	1.716	1.733	1.751	1.768	1.786	1.804
0.6	1.822	1.840	1.859	1.878	1.896	1.916	1.935	1.954	1.974	1.994
0.7	2.014	2.034	2.054	2.075	2.096	2.117	2.138	2.160	2.181	2.203
0.8	2.226	2.248	2.270	2.293	2.316	2.340	2.363	2.387	2.411	2.435
0.9	2.460	2.484	2.509	2.535	2.560	2.586	2.612	2.638	2.664	2.691

	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
1	2.718	3.004	3.320	3.669	4.055	4.482	4.953	5.474	6.050	6.686
2	7.389	8.166	9.025	9.974	11.02	12.18	13.46	14.88	16.44	18.17
3	20.09	22.20	24.53	27.11	29.96	33.12	36.60	40.45	44.70	49.40
4	54.60	60.34	66.69	73.70	81.45	90.02	99.48	110.0	121.5	134.3
5	148.4	164.0	181.3	200.3	221.4	244.7	270.4	298.9	330.3	365.0
6	403.4	445.9	492.8	544.6	601.9	665.1	735.1	812.4	897.9	992.3
7	1097	1212	1339	1480	1636	1808	1998	2208	2441	2697
8	2981	3295	3641	4024	4447	4915	5432	6003	6634	7332
9	8103	8955	9897	10938	12088	13360	14765	16318	18034	19930
10	22026									

EXPONENTIALS (Continued)

This table gives the values of e^{-n} for the values of n shown at the side and top.

	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	1.000	0.990	0.980	0.970	0.961	0.951	0.942	0.932	0.923	0.914
0.1	0.905	0.896	0.887	0.878	0.869	0.861	0.852	0.844	0.835	0.827
0.2	0.819	0.811	0.803	0.795	0.787	0.779	0.771	0.763	0.756	0.748
0.3	0.741	0.733	0.726	0.719	0.712	0.705	0.698	0.691	0.684	0.677
0.4	0.670	0.664	0.657	0.651	0.644	0.638	0.631	0.625	0.619	0.613
0.5	0.607	0.600	0.595	0.589	0.583	0.577	0.571	0.566	0.560	0.554
0.6	0.549	0.543	0.538	0.533	0.527	0.522	0.517	0.512	0.507	0.502
0.7	0.497	0.492	0.487	0.482	0.477	0.472	0.468	0.463	0.458	0.454
0.8	0.449	0.445	0.440	0.436	0.432	0.427	0.423	0.419	0.415	0.411
0.9	0.407	0.403	0.399	0.395	0.391	0.387	0.383	0.379	0.375	0.372
1.0	0.368									

	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
1.0	0.368	0.333	0.301	0.273	0.247	0.223	0.202	0.183	0.165	0.150
2.0	0.135	0.122	0.111	0.100	0.0907	0.0821	0.0743	0.0672	0.0608	0.0550
3.0	0.0498	0.0450	0.0408	0.0369	0.0334	0.0302	0.0273	0.0247	0.0224	0.0202
4.0	0.0183	0.0166	0.0150	0.0136	0.0123	0.0111	0.0101	0.00910	0.00823	0.00745
5.0	0.00674	0.00610	0.00552	0.00499	0.00452	0.00409	0.00370	0.00335	0.00303	0.00274
6.0	0.00248	0.00224	0.00203	0.00184	0.00166	0.00150	0.00136	0.00123	0.00111	0.00101
7.0	0.000912	0.000825	0.000747	0.000676	0.000611	0.000553	0.000500	0.000453	0.000410	0.000371
8.0	0.000335	0.000304	0.000275	0.000249	0.000225	0.000203	0.000184	0.000167	0.000151	0.000136
9.0	0.000123	0.000112	0.000101	0.000091	0.000083	0.000075	0.000068	0.000061	0.000055	0.000050
10.0	0.000045									

HYPERBOLIC FUNCTIONS

x	Sinh x Value	Sinh x $\log_{10}$	Cosh x Value	Cosh x $\log_{10}$	Tanh x Value	x	Sinh x Value	Sinh x $\log_{10}$	Cosh x Value	Cosh x $\log_{10}$	Tanh x Value
0.00	0.0000	$-\infty$	1.0000	.00000	.00000	**0.50**	0.5211	.71692	1.1276	.05217	.46212
0.01	0.0100	.00001	1.0001	.00002	.01000	0.51	0.5324	.72624	1.1329	.05419	.46995
0.02	0.0200	.30106	1.0002	.00009	.02000	0.52	0.5438	.73540	1.1383	.05625	.47770
0.03	0.0300	.47719	1.0005	.00020	.02999	0.53	0.5552	.74442	1.1438	.05834	.48538
0.04	0.0400	.60218	1.0008	.00035	.03998	0.54	0.5666	.75330	1.1494	.06046	.49299
0.05	0.0500	.69915	1.0013	.00054	.04996	0.55	0.5782	.76204	1.1551	.06262	.50052
0.06	0.0600	.77841	1.0018	.00078	.05993	0.56	0.5897	.77065	1.1609	.06481	.50798
0.07	0.0701	.84545	1.0025	.00106	.06989	0.57	0.6014	.77914	1.1669	.06703	.51536
0.08	0.0801	.90355	1.0032	.00139	.07983	0.58	0.6131	.78751	1.1730	.06929	.52267
0.09	0.0901	.95483	1.0041	.00176	.08976	0.59	0.6248	.79576	1.1792	.07157	.52990
0.10	0.1002	.00072	1.0050	.00217	.09967	**0.60**	0.6367	.80390	1.1855	.07389	.53705
0.11	0.1102	.04227	1.0061	.00262	.10956	0.61	0.6485	.81194	1.1919	.07624	.54413
0.12	0.1203	.08022	1.0072	.00312	.11943	0.62	0.6605	.81987	1.1984	.07861	.55113
0.13	0.1304	.11517	1.0085	.00366	.12927	0.63	0.6725	.82770	1.2051	.08102	.55805
0.14	0.1405	.14755	1.0098	.00424	.13909	0.64	0.6846	.83543	1.2119	.08346	.56490
0.15	0.1506	.17772	1.0113	.00487	.14889	0.65	0.6967	.84308	1.2188	.08593	.57167
0.16	0.1607	.20597	1.0128	.00554	.15865	0.66	0.7090	.85063	1.2258	.08843	.57836
0.17	0.1708	.23254	1.0145	.00625	.16838	0.67	0.7213	.85809	1.2330	.09095	.58498
0.18	0.1810	.25762	1.0162	.00700	.17808	0.68	0.7336	.86548	1.2402	.09351	.59152
0.19	0.1911	.28136	1.0181	.00779	.18775	0.69	0.7461	.87278	1.2476	.09609	.59798
0.20	0.2013	.30392	1.0201	.00863	.19738	**0.70**	0.7586	.88000	1.2552	.09870	.60437
0.21	0.2115	.32541	1.0221	.00951	.20697	0.71	0.7712	.88715	1.2628	.10134	.61068
0.22	0.2218	.34592	1.0243	.01043	.21652	0.72	0.7838	.89423	1.2706	.10401	.61691
0.23	0.2320	.36555	1.0266	.01139	.22603	0.73	0.7966	.90123	1.2785	.10670	.62307
0.24	0.2423	.38437	1.0289	.01239	.23550	0.74	0.8094	.90817	1.2865	.10942	.62915
0.25	0.2526	.40245	1.0314	.01343	.24492	0.75	0.8223	.91504	1.2947	.11216	.63515
0.26	0.2629	.41986	1.0340	.01452	.25430	0.76	0.8353	.92185	1.3030	.11493	.64108
0.27	0.2733	.43663	1.0367	.01564	.26362	0.77	0.8484	.92859	1.3114	.11773	.64693
0.28	0.2837	.45282	1.0395	.01681	.27291	0.78	0.8615	.93527	1.3199	.12055	.65271
0.29	0.2941	.46847	1.0423	.01801	.28213	0.79	0.8748	.94190	1.3286	.12340	.65841
0.30	0.3045	.48362	1.0453	.01926	.29131	**0.80**	0.8881	.94846	1.3374	.12627	.66404
0.31	0.3150	.49830	1.0484	.02054	.30044	0.81	0.9015	.95498	1.3464	.12917	.66959
0.32	0.3255	.51254	1.0516	.02187	.30951	0.82	0.9150	.96144	1.3555	.13209	.67507
0.33	0.3360	.52637	1.0549	.02323	.31852	0.83	0.9286	.96784	1.3647	.13503	.68048
0.34	0.3466	.53981	1.0584	.02463	.32748	0.84	0.9423	.97420	1.3740	.13800	.68581
0.35	0.3572	.55290	1.0619	.02607	.33638	0.85	0.9561	.98051	1.3835	.14099	.69107
0.36	0.3678	.56564	1.0655	.02755	.34521	0.86	0.9700	.98677	1.3932	.14400	.69626
0.37	0.3785	.57807	1.0692	.02907	.35399	0.87	0.9840	.99299	1.4029	.14704	.70137
0.38	0.3892	.59019	1.0731	.03063	.36271	0.88	0.9981	.99916	1.4128	.15009	.70642
0.39	0.4000	.60202	1.0770	.03222	.37136	0.89	1.0122	.00528	1.4229	.15317	.71139
0.40	0.4108	.61358	1.0811	.03385	.37995	**0.90**	1.0265	.01137	1.4331	.15627	.71630
0.41	0.4216	.62488	1.0852	.03552	.38847	0.91	1.0409	.01741	1.4434	.15939	.72113
0.42	0.4325	.63594	1.0895	.03723	.39693	0.92	1.0554	.02341	1.4539	.16254	.72590
0.43	0.4434	.64677	1.0939	.03897	.40532	0.93	1.0700	.02937	1.4645	.16570	.73059
0.44	0.4543	.65738	1.0984	.04075	.41364	0.94	1.0847	.03530	1.4753	.16888	.73522
0.45	0.4653	.66777	1.1030	.04256	.42190	0.95	1.0995	.04119	1.4862	.17208	.73978
0.46	0.4764	.67797	1.1077	.04441	.43008	0.96	1.1144	.04704	1.4973	.17531	.74428
0.47	0.4875	.68797	1.1125	.04630	.43820	0.97	1.1294	.05286	1.5085	.17855	.74870
0.48	0.4986	.69779	1.1174	.04822	.44624	0.98	1.1446	.05864	1.5199	.18181	.75307
0.49	0.5098	.70744	1.1225	.05018	.45422	0.99	1 1598	.06439	1.5314	.18509	.75736
0.50	0.5211	.71692	1.1276	.05217	.46212	**1.00**	1.1752	.07011	1.5431	.18839	.76159

HYPERBOLIC FUNCTIONS (Continued)

x	Sinh x Value	Sinh x $\log_{10}$	Cosh x Value	Cosh x $\log_{10}$	Tanh x Value
1.00	1.1752	.07011	1.5431	.18839	.76159
1.01	1.1907	.07580	1.5549	.19171	.76576
1.02	1.2063	.08146	1.5669	.19504	.76987
1.03	1.2220	.08708	1.5790	.19839	.77391
1.04	1.2379	.09268	1.5913	.20176	.77789
1.05	1.2539	.09825	1.6038	.20515	.78181
1.06	1.2700	.10379	1.6164	.20855	.78566
1.07	1.2862	.10930	1.6292	.21197	.78946
1.08	1.3025	.11479	1.6421	.21541	.79320
1.09	1.3190	.12025	1.6552	.21886	.79688
1.10	1.3356	.12569	1.6685	.22233	.80050
1.11	1.3524	.13111	1.6820	.22582	.80406
1.12	1.3693	.13649	1.6956	.22931	.80757
1.13	1.3863	.14186	1.7093	.23283	.81102
1.14	1.4035	.14720	1.7233	.23636	.81441
1.15	1.4208	.15253	1.7374	.23990	.81775
1.16	1.4382	.15783	1.7517	.24346	.82104
1.17	1.4558	.16311	1.7662	.24703	.82427
1.18	1.4735	.16836	1.7808	.25062	.82745
1.19	1.4914	.17360	1.7957	.25422	.83058
1.20	1.5085	.17882	1.8107	.25784	.83365
1.21	1.5276	.18402	1.8258	.26146	.83668
1.22	1.5460	.18920	1.8412	.26510	.83965
1.23	1.5645	.19437	1.8568	.26876	.84258
1.24	1.5831	.19951	1.8725	.27242	.84546
1.25	1.6019	.20464	1.8884	.27610	.84828
1.26	1.6209	.20975	1.9045	.27979	.85106
1.27	1.6400	.21485	1.9208	.28349	.85380
1.28	1.6593	.21993	1.9373	.28721	.85648
1.29	1.6788	.22499	1.9540	.29093	.85913
1.30	1.6984	.23004	1.9709	.29467	.86172
1.31	1.7182	.23507	1.9880	.29842	.86428
1.32	1.7381	.24009	2.0053	.30217	.86678
1.33	1.7583	.24509	2.0228	.30594	.86925
1.34	1.7786	.25008	2.0404	.30972	.87167
1.35	1.7991	.25505	2.0583	.31352	.87405
1.36	1.8198	.26002	2.0764	.31732	.87639
1.37	1.8406	.26496	2.0947	.32113	.87869
1.38	1.8617	.26990	2.1132	.32495	.88095
1.39	1.8829	.27482	2.1320	.32878	.88317
1.40	1.9043	.27974	2.1509	.33262	.88535
1.41	1.9259	.28464	2.1700	.33647	.88749
1.42	1.9477	.28952	2.1894	.34033	.88960
1.43	1.9697	.29440	2.2090	.34420	.89167
1.44	1.9919	.29926	2.2288	.34807	.89370
1.45	2.0143	.30412	2.2488	.35196	.89569
1.46	2.0369	.30896	2.2691	.35585	.89765
1.47	2.0597	.31379	2.2896	.35976	.89958
1.48	2.0827	.31862	2.3103	.36367	.90147
1.49	2.1059	.32343	2.3312	.36759	.90332
1.50	2.1293	.32823	2.3524	.37151	.90515

x	Sinh x Value	Sinh x $\log_{10}$	Cosh x Value	Cosh x $\log_{10}$	Tanh x Value
1.50	2.1293	.32823	2.3524	.37151	.90515
1.51	2.1529	.33303	2.3738	.37545	.90694
1.52	2.1768	.33781	2.3955	.37939	.90870
1.53	2.2008	.34258	2.4174	.38334	.91042
1.54	2.2251	.34735	2.4395	.38730	.91212
1.55	2.2496	.35211	2.4619	.39126	.91379
1.56	2.2743	.35686	2.4845	.39524	.91542
1.57	2.2993	.36160	2.5073	.39921	.91703
1.58	2.3245	.36633	2.5305	.40320	.91860
1.59	2.3499	.37105	2.5538	.40719	.92015
1.60	2.3756	.37577	2.5775	.41119	.92167
1.61	2.4015	.38048	2.6013	.41520	.92316
1.62	2.4276	.38518	2.6255	.41921	.92462
1.63	2.4540	.38987	2.6499	.42323	.92606
1.64	2.4806	.39456	2.6746	.42725	.92747
1.65	2.5075	.39923	2.6995	.43129	.92886
1.66	2.5345	.40391	2.7247	.43532	.93022
1.67	2.5620	.40857	2.7502	.43937	.93155
1.68	2.5896	.41323	2.7760	.44341	.93286
1.69	2.6175	.41788	2.8020	.44747	.93415
1.70	2.6456	.42253	2.8283	.45153	.93541
1.71	2.6740	.42717	2.8549	.45559	.93665
1.72	2.7027	.43180	2.8818	.45966	.93786
1.73	2.7317	.43643	2.9090	.46374	.93906
1.74	2.7609	.44105	2.9364	.46782	.94023
1.75	2.7904	.44567	2.9642	.47191	.94138
1.76	2.8202	.45028	2.9922	.47600	.94250
1.77	2.8503	.45488	3.0206	.48009	.94361
1.78	2.8806	.45948	3.0492	.48419	.94470
1.79	2.9112	.46408	3.0782	.48830	.94576
1.80	2.9422	.46867	3.1075	.49241	.94681
1.81	2.9734	.47325	3.1371	.49652	.94783
1.82	3.0049	.47783	3.1669	.50064	.94884
1.83	3.0367	.48241	3.1972	.50476	.94983
1.84	3.0689	.48698	3.2277	.50889	.95080
1.85	3.1013	.49154	3.2585	.51302	.95175
1.86	3.1340	.49610	3.2897	.51716	.95268
1.87	3.1671	.50066	3.3212	.52130	.95359
1.88	3.2005	.50521	3.3530	.52544	.95449
1.89	3.2341	.50976	3.3852	.52959	.95537
1.90	3.2682	.51430	3.4177	.53374	.95624
1.91	3.3025	.51884	3.4506	.53789	.95709
1.92	3.3372	.52338	3.4838	.54205	.95792
1.93	3.3722	.52791	3.5173	.54621	.95873
1.94	3.4075	.53244	3.5512	.55038	.95953
1.95	3.4432	.53696	3.5855	.55455	.96032
1.96	3.4792	.54148	3.6201	.55872	.96109
1.97	3.5156	.54600	3.6551	.56290	.96185
1.98	3.5523	.55051	3.6904	.56707	.96259
1.99	3.5894	.55502	3.7261	.57126	.96331
2.00	3.6269	.55953	3.7622	.57544	.96403

HYPERBOLIC FUNCTIONS (Continued)

x	Sinh x Value	Sinh x $\log_{10}$	Cosh x Value	Cosh x $\log_{10}$	Tanh x Value	x	Sinh x Value	Sinh x $\log_{10}$	Cosh x Value	Cosh x $\log_{10}$	Tanh x Value
2.00	3.6269	.55953	3.7622	.57544	.96403	**2.50**	6.0502	.78177	6.1323	.78762	.98661
2.01	3.6647	.56403	3.7987	.57963	.96473	2.51	6.1118	.78617	6.1931	.79191	.98688
2.02	3.7028	.56853	3.8355	.58382	.96541	2.52	6.1741	.79057	6.2545	.79619	.98714
2.03	3.7414	.57303	3.8727	.58802	.96609	2.53	6.2369	.79497	6.3166	.80048	.98739
2.04	3.7803	.57753	3.9103	.59221	.96675	2.54	6.3004	.79937	6.3793	.80477	.98764
2.05	3.8196	.58202	3.9483	.59641	.96740	2.55	6.3645	.80377	6.4426	.80906	.98788
2.06	3.8593	.58650	3.9867	.60061	.96803	2.56	6.4293	.80816	6.5066	.81335	.98812
2.07	3.8993	.59099	4.0255	.60482	.96865	2.57	6.4946	.81256	6.5712	.81764	.98835
2.08	3.9398	.59547	4.0647	.60903	.96926	2.58	6.5607	.81695	6.6365	.82194	.98858
2.09	3.9806	.59995	4.1043	.61324	.96986	2.59	6.6274	.82134	6.7024	.82623	.98881
2.10	4.0219	.60443	4.1443	.61745	.97045	**2.60**	6.6947	.82573	6.7690	.83052	.98903
2.11	4.0635	.60890	4.1847	.62167	.97103	2.61	6.7628	.83012	6.8363	.83482	.98924
2.12	4.1056	.61337	4.2256	.62589	.97159	2.62	6.8315	.83451	6.9043	.83912	.98946
2.13	4.1480	.61784	4.2669	.63011	.97215	2.63	6.9008	.83890	6.9729	.84341	.98966
2.14	4.1909	.62231	4.3085	.63433	.97269	2.64	6.9709	.84329	7.0423	.84771	.98987
2.15	4.2342	.62677	4.3507	.63856	.97323	2.65	7.0417	.84768	7.1123	.85201	.99007
2.16	4.2779	.63123	4.3932	.64278	.97375	2.66	7.1132	.85206	7.1831	.85631	.99026
2.17	4.3221	.63569	4.4362	.64701	.97426	2.67	7.1854	.85645	7.2546	.86061	.99045
2.18	4.3666	.64015	4.4797	.65125	.97477	2.68	7.2583	.86083	7.3268	.86492	.99064
2.19	4.4116	.64460	4.5236	.65548	.97526	2.69	7.3319	.86522	7.3998	.86922	.99083
2.20	4.4571	.64905	4.5679	.65972	.97574	**2.70**	7.4063	.86960	7.4735	.87352	.99101
2.21	4.5030	.65350	4.6127	.66396	.97622	2.71	7.4814	.87398	7.5479	.87783	.99118
2.22	4.5494	.65795	4.6580	.66820	.97668	2.72	7.5572	.87836	7.6231	.88213	.99136
2.23	4.5962	.66240	4.7037	.67244	.97714	2.73	7.6338	.88274	7.6991	.88644	.99153
2.24	4.6434	.66684	4.7499	.67668	.97759	2.74	7.7112	.88712	7.7758	.89074	.99170
2.25	4.6912	.67128	4.7966	.68093	.97803	2.75	7.7894	.89150	7.8533	.89505	.99186
2.26	4.7394	.67572	4.8437	.68518	.97846	2.76	7.8683	.89588	7.9316	.89936	.99202
2.27	4.7880	.68016	4.8914	.68943	.97888	2.77	7.9480	.90026	8.0106	.90367	.99218
2.28	4.8372	.68459	4.9395	.69368	.97929	2.78	8.0285	.90463	8.0905	.90798	.99233
2.29	4.8868	.68903	4.9881	.69794	.97970	2.79	8.1098	.90901	8.1712	.91229	.99248
2.30	4.9370	.69346	5.0372	.70219	.98010	**2.80**	8.1919	.91339	8.2527	.91660	.99263
2.31	4.9876	.69789	5.0868	.70645	.98049	2.81	8.2749	.91776	8.3351	.92091	.99278
2.32	5.0387	.70232	5.1370	.71071	.98087	2.82	8.3586	.92213	8.4182	.92522	.99292
2.33	5.0903	.70675	5.1876	.71497	.98124	2.83	8.4432	.92651	8.5022	.92953	.99306
2.34	5.1425	.71117	5.2388	.71923	.98161	2.84	8.5287	.93088	8.5871	.93385	.99320
2.35	5.1951	.71559	5.2905	.72349	.98197	2.85	8.6150	.93525	8.6728	.93816	.99333
2.36	5.2483	.72002	5.3427	.72776	.98233	2.86	8.7021	.93963	8.7594	.94247	.99346
2.37	5.3020	.72444	5.3954	.73203	.98267	2.87	8.7902	.94400	8.8469	.94679	.99359
2.38	5.3562	.72885	5.4487	.73630	.98301	2.88	8.8791	.94837	8.9352	.95110	.99372
2.39	5.4109	.73327	5.5026	.74056	.98335	2.89	8.9689	.95274	9.0244	.95542	.99384
2.40	5.4662	.73769	5.5569	.74484	.98367	**2.90**	9.0596	.95711	9.1146	.95974	.99396
2.41	5.5221	.74210	5.6119	.74911	.98400	2.91	9.1512	.96148	9.2056	.96405	.99408
2.42	5.5785	.74652	5.6674	.75338	.98431	2.92	9.2437	.96584	9.2976	.96837	.99420
2.43	5.6354	.75093	5.7235	.75766	.98462	2.93	9.3371	.97021	9.3905	.97269	.99431
2.44	5.6929	.75534	5.7801	.76194	.98492	2.94	9.4315	.97458	9.4844	.97701	.99443
2.45	5.7510	.75975	5.8373	.76621	.98522	2.95	9.5268	.97895	9.5791	.98133	.99454
2.46	5.8097	.76415	5.8951	.77049	.98551	2.96	9.6231	.98331	9.6749	.98565	.99464
2.47	5.8689	.76856	5.9535	.77477	.98579	2.97	9.7203	.98768	9.7716	.98997	.99475
2.48	5.9288	.77296	6.0125	.77906	.98607	2.98	9.8185	.99205	9.8693	.99429	.99485
2.49	5.9892	.77737	6.0721	.78334	.98635	2.99	9.9177	.99641	9.9680	.99861	.99496
2.50	6.0502	.78177	6.1323	.78762	.98661	**3.00**	10.018	.00078	10.068	.00293	.99505

HYPERBOLIC FUNCTIONS (Continued)

x	Sinh x Value	Sinh x $\log_{10}$	Cosh x Value	Cosh x $\log_{10}$	Tanh x Value	x	Sinh x Value	Sinh x $\log_{10}$	Cosh x Value	Cosh x $\log_{10}$	x
3.00	10.018	.00078	10.068	.00293	.99505	**5.00**	74 203	.87042	74.210	.87046	.99991
3.05	10.534	.02259	10.581	.02454	.99552	5.10	82.011	.91386	82.014	.91389	.99993
3.10	11.076	.04440	11.122	.04616	.99595	5.20	90.633	.95729	90.639	.95731	.99994
3.15	11.646	.06619	11.690	.06780	.99631	5.30	100.17	.00074	100.17	.00074	.99995
3.20	12.246	.08799	12.287	.08943	.99668	5.40	110.70	.04415	110.71	.04417	.99996
3.25	12.876	.10977	12.915	.11108	.99700	5.50	122.34	.08758	122 35	.08760	.99997
3.30	13.538	.13155	13.575	.13273	.99728	5.60	135.21	.13101	135.22	.13103	.99997
3.35	14.234	.15332	14.269	.15439	.99754	5.70	149.43	.17444	149.44	.17445	.99998
3.40	14.965	.17509	14.999	.17605	.99777	5.80	165.15	.21787	165.15	.21788	.99998
3.45	15.734	.19685	15.766	.19772	.99799	5.90	182.52	.26130	182.52	.26131	.99998
3.50	16.543	.21860	16.573	.21940	.99818	**6.00**	201.71	.30473	201.72	.30474	.99999
3 55	17.392	.24036	17.421	.24107	.99833	6.25	259.01	.41331	259.01	.41331	.99999
3.60	18.286	.26211	18.313	.26275	.99851	6.50	332.57	.52188	332.57	.52189	1.0000
3.65	19.224	.28385	19.250	.28444	.99865	6.75	427.03	.63046	427.03	.63046	1.0000
3.70	20.211.	.30559	20.236	.30612	.99878	7.00	548.32	.73903	548.32	.73903	1.0000
3.75	21.249	.32733	21.272	.32781	.99889	7.50	904.02	.95618	904.02	.95618	1.0000
3.80	22.339	.34907	22.362	.34951	.99900	8.00	1490.5	.17333	1490.5	.17333	1.0000
3.85	23.486	.37081	23.507	.37120	.99909	8.50	2457.4	.39047	2457.4	.39047	1.0000
3.90	24.691	.39254	24.711	.39290	.99918	9.00	4051.5	.60762	4051.5	.60762	1.0000
3.95	25.958	.41427	25.977	.41459	.99926	9.50	6679.9	.82477	6679.9	.82477	1.0000
4.00	27.290	.43600	27.308	.43629	.99933	**10.00**	11013.	.04191	11013.	.04191	1.0000
4.10	30.162	.47946	30.178	.47970	.99945						
4.20	33.336	.52291	33.351	.52310	.99955						
4.30	36.843	.56636	36.857	.56652	.99963						
4.40	40.719	.60980	40.732	.60993	.99970						
4.50	45.003	.65324	45.014	.65335	.99975						
4.60	49.737	.69668	49.747	.69677	.99980						
4.70	54.969	.74012	54.978	.74019	.99983						
4.80	60.751	.78355	60.759	.78361	.99986						
4.90	67.141	.82699	67.149	.82704	.99989						

DEGREES — RADIANS

The table gives in radians the angle which is expressed in degrees and minutes at the side and top.

°	00′	10	20	30	40	50
0	0.0000	0.0029	0.0058	0.0087	0.0116	0.0145
1	0.0175	0.0204	0.0233	0.0262	0.0291	0.0320
2	0.0349	0.0378	0.0407	0.0436	0.0465	0.0495
3	0.0524	0.0553	0.0582	0.0611	0.0640	0.0669
4	0.0698	0.0727	0.0756	0.0785	0.0814	0.0844
5	0.0873	0.0902	0.0931	0.0960	0.0989	0.1018
6	0.1047	0.1076	0.1105	0.1134	0.1164	0.1193
7	0.1222	0.1251	0.1280	0.1309	0.1338	0.1367
8	0.1396	0.1425	0.1454	0.1484	0.1513	0.1542
9	0.1571	0.1600	0.1629	0.1658	0.1687	0.1716
10	0.1745	0.1774	0.1804	0.1833	0.1862	0.1891
11	0.1920	0.1949	0.1978	0.2007	0.2036	0.2065
12	0.2094	0.2123	0.2153	0.2182	0.2211	0.2240
13	0.2269	0.2298	0.2327	0.2356	0.2385	0.2414
14	0.2443	0.2473	0.2502	0.2531	0.2560	0.2589
15	0.2618	0.2647	0.2676	0.2705	0.2734	0.2763
16	0.2793	0.2822	0.2851	0.2880	0.2909	0.2938
17	0.2967	0.2996	0.3025	0.3054	0.3083	0.3113
18	0.3142	0.3171	0.3200	0.3229	0.3258	0.3287
19	0.3316	0.3345	0.3374	0.3403	0.3432	0.3462
20	0.3491	0.3520	0.3549	0.3578	0.3607	0.3636
21	0.3665	0.3694	0.3723	0.3752	0.3782	0.3811
22	0.3840	0.3869	0.3898	0.3927	0.3956	0.3985
23	0.4014	0.4043	0.4072	0.4102	0.4131	0.4160
24	0.4189	0.4218	0.4247	0.4276	0.4305	0.4334
25	0.4363	0.4392	0.4422	0.4451	0.4480	0.4509
26	0.4538	0.4567	0.4596	0.4625	0.4654	0.4683
27	0.4712	0.4741	0.4771	0.4800	0.4829	0.4858
28	0.4887	0.4916	0.4945	0.4974	0.5003	0.5032
29	0.5061	0.5091	0.5120	0.5149	0.5178	0.5207
30	0.5236	0.5265	0.5294	0.5323	0.5352	0.5381
31	0.5411	0.5440	0.5469	0.5498	0.5527	0.5556
32	0.5585	0.5614	0.5643	0.5672	0.5701	0.5730
33	0.5760	0.5789	0.5818	0.5847	0.5876	0.5905
34	0.5934	0.5963	0.5992	0.6021	0.6050	0.6080
35	0.6109	0.6138	0.6167	0.6196	0.6225	0.6254
36	0.6283	0.6312	0.6341	0.6370	0.6400	0.6429
37	0.6458	0.6487	0.6516	0.6545	0.6574	0.6603
38	0.6632	0.6661	0.6690	0.6720	0.6749	0.6778
39	0.6807	0.6836	0.6865	0.6894	0.6923	0.6952
40	0.6981	0.7010	0.7039	0.7069	0.7098	0.7127
41	0.7156	0.7185	0.7214	0.7243	0.7272	0.7301
42	0.7330	0.7359	0.7389	0.7418	0.7447	0.7476
43	0.7505	0.7534	0.7563	0.7592	0.7621	0.7650
44	0.7679	0.7709	0.7738	0.7767	0.7796	0.7825

DEGREES — RADIANS (Continued)

°	00′	10	20	30	40	50
45	0.7854	0.7883	0.7912	0.7941	0.7970	0.7999
46	0.8029	0.8058	0.8087	0.8116	0.8145	0.8174
47	0.8203	0.8232	0.8261	0.8290	0.8319	0.8348
48	0.8378	0.8407	0.8436	0.8465	0.8494	0.8523
49	0.8552	0.8581	0.8610	0.8639	0.8668	0.8698
50	0.8727	0.8756	0.8785	0.8814	0.8843	0.8872
51	0.8901	0.8930	0.8959	0.8988	0.9018	0.9047
52	0.9076	0.9105	0.9134	0.9163	0.9192	0.9221
53	0.9250	0.9279	0.9308	0.9338	0.9367	0.9396
54	0.9425	0.9454	0.9483	0.9512	0.9541	0.9570
55	0.9599	0.9628	0.9657	0.9687	0.9716	0.9745
56	0.9774	0.9803	0.9832	0.9861	0.9890	0.9919
57	0.9948	0.9977	1.0007	1.0036	1.0065	1.0094
58	1.0123	1.0152	1.0181	1.0210	1.0239	1.0268
59	1.0297	1.0327	1.0356	1.0385	1.0414	1.0443
60	1.0472	1.0501	1.0530	1.0559	1.0588	1.0617
61	1.0647	1.0676	1.0705	1.0734	1.0763	1.0792
62	1.0821	1.0850	1.0879	1.0908	1.0937	1.0966
63	1.0996	1.1025	1.1054	1.1083	1.1112	1.1141
64	1.1170	1.1199	1.1228	1.1257	1.1286	1.1316
65	1.1345	1.1374	1.1403	1.1432	1.1461	1.1490
66	1.1519	1.1548	1.1577	1.1606	1.1636	1.1665
67	1.1694	1.1723	1.1752	1.1781	1.1810	1.1839
68	1.1868	1.1897	1.1926	1.1956	1.1985	1.2014
69	1.2043	1.2072	1.2101	1.2130	1.2159	1.2188
70	1.2217	1.2246	1.2275	1.2305	1.2334	1.2363
71	1.2392	1.2421	1.2450	1.2479	1.2508	1.2537
72	1.2566	1.2595	1.2625	1.2654	1.2683	1.2712
73	1.2741	1.2770	1.2799	1.2828	1.2857	1.2886
74	1.2915	1.2945	1.2974	1.3003	1.3032	1.3061
75	1.3090	1.3119	1.3148	1.3177	1.3206	1.3235
76	1.3265	1.3294	1.3323	1.3352	1.3381	1.3410
77	1.3439	1.3468	1.3497	1.3526	1.3555	1.3584
78	1.3614	1.3643	1.3672	1.3701	1.3730	1.3759
79	1.3788	1.3817	1.3846	1.3875	1.3904	1.3934
80	1.3963	1.3992	1.4021	1.4050	1.4079	1.4108
81	1.4137	1.4166	1.4195	1.4224	1.4254	1.4283
82	1.4312	1.4341	1.4370	1.4399	1.4428	1.4457
83	1.4486	1.4515	1.4544	1.4574	1.4603	1.4632
84	1.4661	1.4690	1.4719	1.4748	1.4777	1.4806
85	1.4835	1.4864	1.4893	1.4923	1.4952	1.4981
86	1.5010	1.5039	1.5068	1.5097	1.5126	1.5155
87	1.5184	1.5213	1.5243	1.5272	1.5301	1.5330
88	1.5359	1.5388	1.5417	1.5446	1.5475	1.5504
89	1.5533	1.5563	1.5592	1.5621	1.5650	1.5679
90	1.5708					

DEGREES — RADIANS (Concluded)

Deg.	Radians.	Deg.	Radians.	Deg.	Radians.	Deg.	Radians.
90	1.5708	160	2.7925	230	4.0143	300	5.2360
100	1.7453	170	2.9671	240	4.1888	310	5.4105
110	1.9199	180	3.1416	250	4.3633	320	5.5851
120	2.0944	190	3.3161	260	4.5379	330	5.7596
130	2.2689	200	3.4907	270	4.7124	340	5.9341
140	2.4435	210	3.6652	280	4.8869	350	6.1087
150	2.6180	220	3.8397	290	5.0615	360	6.2832

NUMERICAL CONSTANTS

$\pi = 3.14159$	$\log \pi = 0.497150$
$4\pi = 12.56637$	$\log 4\pi = 1.099210$
$\frac{\pi}{2} = 1.57080$	$\log \frac{\pi}{2} = 0.196120$
$\frac{\pi}{3} = 1.04720$	$\log \frac{\pi}{3} = 0.020029$
$\frac{4}{3}\pi = 4.18879$	$\log \frac{4}{3}\pi = 0.622089$
$\frac{\pi}{4} = 0.78540$	$\log \frac{\pi}{4} = 9.895090 - 10$
$\frac{1}{\pi} = 0.31831$	$\log \frac{1}{\pi} = 9.502850 - 10$
$\pi^2 = 9.86960$	$\log \pi^2 = 0.994300$
$4\pi^2 = 39.47840$	$\log 4\pi^2 = 1.596360$
$\frac{1}{\pi^2} = 0.10132$	$\log \frac{1}{\pi^2} = 9.005700 - 10$
$\sqrt{\pi} = 1.77245$	$\log \sqrt{\pi} = 0.248575$
$\frac{1}{\sqrt{\pi}} = 0.56419$	$\log \frac{1}{\sqrt{\pi}} = 9.751425 - 10$
$\sqrt[3]{\pi} = 1.46459$	$\log \sqrt[3]{\pi} = 0.165717$

BASE OF NATURAL LOGARITHMS

$e = 2.71828$ $\quad \log_{10} e = 0.434294$

Natural log of $x = \log_e x = 2.30259 \log_{10} x$.

For conversion or reduction factors see under *Measures and Units*.
For miscellaneous physical constants see under *Miscellaneous Tables*.

NUMERICAL TABLE

RECIPROCALS, POWERS AND ROOTS OF NUMBERS, CIRCUMFERENCES AND AREAS FOR NUMBERS (DIAMETERS) FROM 1 TO 1000

n	$1000\frac{1}{n}$	n^2	n^3	$\sqrt{n}$	$\sqrt[3]{n}$	Circum. of circle πn	Area of circle $\frac{1}{4}\pi n^2$
1	1000.00	1	1	1.	1.00000	3.14159	.79
2	500.00	4	8	1.414	1.25992	6.28319	3.14
3	333.33	9	27	1.732	1.44225	9.42478	7.07
4	250.00	16	64	2.000	1.58740	12.5664	12.57
5	200.00	25	125	2.236	1.70998	15.7080	19.64
6	166.67	36	216	2.449	1.81712	18.8496	28.27
7	142.86	49	343	2.646	1.91293	21.9911	38.49
8	125.00	64	512	2.828	2.00000	25.1327	50.27
9	111.11	81	729	3.000	2.08008	28.2743	63.62
10	100.00	100	1000	3.162	2.15443	31.4159	78.5
11	90.9091	121	1331	3.3166	2.22398	34.5575	95.0
12	83.3333	144	1728	3.4641	2.28943	37.6991	113.1
13	76.9231	169	2197	3.6056	2.35133	40.8407	132.7
14	71.4286	196	2744	3.7417	2.41014	43.9823	153.9
15	66.6667	225	3375	3.8730	2.46621	47.1239	176.7
16	62.5000	256	4096	4.0000	2.51984	50.2655	201.1
17	58.8235	289	4913	4.1231	2.57128	53.4071	227.0
18	55.5556	324	5832	4.2426	2.62074	56.5487	254.5
19	52.6316	361	6859	4.3589	2.66840	59.6903	283.5
20	50.0000	400	8000	4.4721	2.71442	62.8319	314.2
21	47.6190	441	9261	4.5826	2.75892	65.9734	346.4
22	45.4545	484	10648	4.6904	2.80204	69.1150	380.1
23	43.4783	529	12167	4.7958	2.84387	72.2566	415.5
24	41.6667	576	13824	4.8990	2.88450	75.3982	452.4
25	40.0000	625	15625	5.0000	2.92402	78.5398	490.9
26	38.4615	676	17576	5.0990	2.96250	81.6814	530.9
27	37.0370	729	19683	5.1962	3.00000	84.8230	572.6
28	35.7143	784	21952	5.2915	3.03659	87.9646	615.8
29	34.4828	841	24389	5.3852	3.07232	91.1062	660.5
30	33.3333	900	27000	5.4772	3.10723	94.2478	706.9
31	32.2581	961	29791	5.5678	3.14138	97.3894	754.8
32	31.2500	1024	32768	5.6569	3.17480	100.531	804.3
33	30.3030	1089	35937	5.7446	3.20753	103.673	855.3
34	29.4118	1156	39304	5.8310	3.23961	106.814	907.9
35	28.5714	1225	42875	5.9161	3.27107	109.956	962.1
36	27.7778	1296	46656	6.0000	3.30193	113.097	1017.9
37	27.0270	1369	50653	6.0828	3.33222	116.239	1075.2
38	26.3158	1444	54872	6.1644	3.36198	119.381	1134.1
39	25.6410	1521	59319	6.2450	3.39121	122.522	1194.6
40	25.0000	1600	64000	6.3246	3.41995	125.664	1256.6
41	24.3902	1681	68921	6.4031	3.44822	128.805	1320.3
42	23.8095	1764	74088	6.4807	3.47603	131.947	1385.4
43	23.2558	1849	79507	6.5574	3.50340	135.088	1452.2
44	22.7273	1936	85184	6.6332	3.53035	138.230	1520.5
45	22.2222	2025	91125	6.7082	3.55689	141.372	1590.4
46	21.7391	2116	97336	6.7823	3.58305	144.513	1661.9
47	21.2766	2209	103823	6.8557	3.60883	147.655	1734.9
48	20.8333	2304	110592	6.9282	3.63424	150.796	1809.6
49	20.4082	2401	117649	7.0000	3.65931	153.938	1885.7
50	20.0000	2500	125000	7.0711	3.68403	157.080	1963.5

NUMERICAL TABLE (Continued)

n	$1000\frac{1}{n}$	n^2	n^3	$\sqrt{n}$	$\sqrt[3]{n}$	Circum. of circle πn	Area of circle $\frac{1}{4}\pi n^2$
51	19.6078	2601	132651	7.1414	3.70843	160.221	2042.8
52	19.2308	2704	140608	7.2111	3.73251	163.363	2123.7
53	18.8679	2809	148877	7.2801	3.75629	166.504	2206.2
54	18.5185	2916	157464	7.3485	3.77976	169.646	2290.2
55	18.1818	3025	166375	7.4162	3.80295	172.788	2375.8
56	17.8571	3136	175616	7.4833	3.82586	175.929	2463.0
57	17.5439	3249	185193	7.5498	3.84850	179.071	2551.8
58	17.2414	3364	195112	7.6158	3.87088	182.212	2642.1
59	16.9492	3481	205379	7.6811	3.89300	185.354	2734.0
60	16.6667	3600	216000	7.7460	3.91487	188.496	2827.4
61	16.3934	3721	226981	7.8102	3.93650	191.637	2922.5
62	16.1290	3844	238328	7.8740	3.95789	194.779	3019.1
63	15.8730	3969	250047	7.9373	3.97906	197.920	3117.3
64	15.6250	4096	262144	8.0000	4.00000	201.062	3217.0
65	15.3846	4225	274625	8.0623	4.02073	204.204	3318.3
66	15.1515	4356	287496	8.1240	4.04124	207.345	3421.2
67	14.9254	4489	300763	8.1854	4.06155	210.487	3525.7
68	14.7059	4624	314432	8.2462	4.08166	213.628	3631.7
69	14.4928	4761	328509	8.3066	4.10157	216.770	3739.3
70	14.2857	4900	343000	8.3666	4.12129	219.911	3848.5
71	14.0845	5041	357911	8.4261	4.14082	223.053	3959.2
72	13.8889	5184	373248	8.4853	4.16017	226.195	4071.5
73	13.6986	5329	389017	8.5440	4.17934	229.336	4185.4
74	13.5135	5476	405224	8.6023	4.19834	232.478	4300.8
75	13.3333	5625	421875	8.6603	4.21716	235.619	4417.9
76	13.1579	5776	438976	8.7178	4.23582	238.761	4536.5
77	12.9870	5929	456533	8.7750	4.25432	241.903	4656.6
78	12.8205	6084	474552	8.8318	4.27266	245.044	4778.4
79	12.6582	6241	493039	8.8882	4.29084	248.186	4901.7
80	12.5000	6400	512000	8.9443	4.30887	251.327	5026.6
81	12.3457	6561	531441	9.0000	4.32675	254.469	5153.0
82	12.1951	6724	551368	9.0554	4.34448	257.611	5281.0
83	12.0482	6889	571787	9.1104	4.36207	260.752	5410.6
84	11.9048	7056	592704	9.1652	4.37952	263.894	5541.8
85	11.7647	7225	614125	9.2195	4.39683	267.035	5674.5
86	11.6279	7396	636056	9.2736	4.41400	270.177	5808.8
87	11.4943	7569	658503	9.3274	4.43105	273.319	5944.7
88	11.3636	7744	681472	9.3808	4.44796	276.460	6082.1
89	11.2360	7921	704969	9.4340	4.46475	279.602	6221.1
90	11.1111	8100	729000	9.4868	4.48140	282.743	6361.7
91	10.9890	8281	753571	9.5394	4.49794	285.885	6503.9
92	10.8696	8464	778688	9.5917	4.51436	289.027	6647.6
93	10.7527	8649	804357	9.6437	4.53065	292.168	6792.9
94	10.6383	8836	830584	9.6954	4.54684	295.310	6939.8
95	10.5263	9025	857375	9.7468	4.56290	298.451	7088.2
96	10.4167	9216	884736	9.7980	4.57886	301.593	7238.2
97	10.3093	9409	912673	9.8489	4.59470	304.734	7389.8
98	10.2041	9604	941192	9.8995	4.61044	307.876	7543.0
99	10.1010	9801	970299	9.9499	4.62607	311.018	7697.7
100	10.0000	10000	1000000	10.0000	4.64159	314.159	7854.0

NUMERICAL TABLE (Continued)

n	$1000\frac{1}{n}$	n^2	n^3	$\sqrt{n}$	$\sqrt[3]{n}$	Circum. of circle πn	Area of circle $\frac{1}{4}\pi n^2$
01	9.90099	10201	1030301	10.0499	4.65701	317.301	8011.9
02	9.80392	10404	1061208	10.0995	4.67233	320.442	8171.3
03	9.70874	10609	1092727	10.1489	4.68755	323.584	8332.3
04	9.61538	10816	1124864	10.1980	4.70267	326.726	8494.9
05	9.52381	11025	1157625	10.2470	4.71769	329.867	8659.0
06	9.43396	11236	1191016	10.2956	4.73262	333.009	8824.7
07	9.34579	11449	1225043	10.3441	4.74746	336.150	8992.0
08	9.25926	11664	1259712	10.3923	4.76220	339.292	9160.9
09	9.17431	11881	1295029	10.4403	4.77686	342.434	9331.3
10	9.09091	12100	1331000	10.4881	4.79142	345.575	9503.3
11	9.00901	12321	1367631	10.5357	4.80590	348.717	9676.9
12	8.92857	12544	1404928	10.5830	4.82028	351.858	9852.0
13	8.84956	12769	1442897	10.6301	4.83459	355.000	10028.8
14	8.77193	12996	1481544	10.6771	4.84881	358.142	10207.0
15	8.69565	13225	1520875	10.7238	4.86294	361.283	10386.9
16	8.62069	13456	1560896	10.7703	4.87700	364.425	10568.3
17	8.54701	13689	1601613	10.8167	4.89097	367.566	10751.3
18	8.47458	13924	1643032	10.8628	4.90487	370.708	10935.9
19	8.40336	14161	1685159	10.9087	4.91868	373.850	11122.0
20	8.33333	14400	1728000	10.9545	4.93242	376.991	11309.7
21	8.26446	14641	1771561	11.0000	4.94609	380.133	11499.0
22	8.19672	14884	1815848	11.0454	4.95968	383.274	11689.9
23	8.13008	15129	1860867	11.0905	4.97319	386.416	11882.3
24	8.06452	15376	1906624	11.1355	4.98663	389.557	12076.3
25	8.00000	15625	1953125	11.1803	5.00000	392.699	12271.9
26	7.93651	15876	2000376	11.2250	5.01330	395.841	12469.0
27	7.87402	16129	2048383	11.2694	5.02653	398.982	12667.7
28	7.81250	16384	2097152	11.3137	5.03968	402.124	12868.0
29	7.75194	16641	2146689	11.3578	5.05277	405.265	13069.8
30	7.69231	16900	2197000	11.4018	5.06580	408.407	13273.2
31	7.63359	17161	2248091	11.4455	5.07875	411.549	13478.2
32	7.57576	17424	2299968	11.4891	5.09164	414.690	13684.8
33	7.51880	17689	2352637	11.5326	5.10447	417.832	13892.9
34	7.46269	17956	2406104	11.5758	5.11723	420.973	14102.6
35	7.40741	18225	2460375	11.6190	5.12993	424.115	14313.9
36	7.35294	18496	2515456	11.6619	5.14256	427.257	14526.7
37	7.29927	18769	2571353	11.7047	5.15514	430.398	14741.1
38	7.24638	19044	2628072	11.7473	5.16765	433.540	14957.1
39	7.19424	19321	2685619	11.7898	5.18010	436.681	15174.7
40	7.14286	19600	2744000	11.8322	5.19249	439.823	15393.8
41	7.09220	19881	2803221	11.8743	5.20483	442.965	15614.5
42	7.04225	20164	2863288	11.9164	5.21710	446.106	15836.8
43	6.99301	20449	2924207	11.9583	5.22932	449.248	16060.6
44	6.94444	20736	2985984	12.0000	5.24148	452.389	16286.0
45	6.89655	21025	3048625	12.0416	5.25359	455.531	16513.0
46	6.84932	21316	3112136	12.0830	5.26564	458.673	16741.6
47	6.80272	21609	3176523	12.1244	5.27763	461.814	16971.7
48	6.75676	21904	3241792	12.1655	5.28957	464.956	17203.4
49	6.71141	22201	3307949	12.2066	5.30146	468.097	17436.6
50	6.66667	22500	3375000	12.2474	5.31329	471.239	17671.5

NUMERICAL TABLE (Continued)

n	$1000\frac{1}{n}$	n^2	n^3	$\sqrt{n}$	$\sqrt[3]{n}$	Circum. of circle πn	Area of circle $\frac{1}{4}\pi n^2$
151	6.62252	22801	3442951	12.2882	5.32507	474.380	17907.9
152	6.57895	23104	3511808	12.3288	5.33680	477.522	18145.8
153	6.53595	23409	3581577	12.3693	5.34848	480.664	18385.4
154	6.49351	23716	3652264	12.4097	5.36011	483.805	18626.5
155	6.45161	24025	3723875	12.4499	5.37169	486.947	18869.2
156	6.41026	24336	3796416	12.4900	5.38321	490.088	19113.5
157	6.36943	24649	3869893	12.5300	5.39469	493.230	19359.3
158	6.32911	24964	3944312	12.5698	5.40612	496.372	19606.7
159	6.28931	25281	4019679	12.6095	5.41750	499.513	19855.7
160	6.25000	25600	4096000	12.6491	5.42884	502.655	20106.2
161	6.21118	25921	4173281	12.6886	5.44012	505.796	20358.3
162	6.17284	26244	4251528	12.7279	5.45136	508.938	20612.0
163	6.13497	26569	4330747	12.7671	5.46256	512.080	20867.2
164	6.09756	26896	4410944	12.8062	5.47370	515.221	21124.1
165	6.06061	27225	4492125	12.8452	5.48481	518.363	21382.5
166	6.02410	27556	4574296	12.8841	5.49586	521.504	21642.4
167	5.98802	27889	4657463	12.9228	5.50688	524.646	21904.0
168	5.95238	28224	4741632	12.9615	5.51785	527.788	22167.1
169	5.91716	28561	4826809	13.0000	5.52877	530.929	22431.8
170	5.88235	28900	4913000	13.0384	5.53966	534.071	22698.0
171	5.84795	29241	5000211	13.0767	5.55050	537.212	22965.8
172	5.81395	29584	5088448	13.1149	5.56130	540.354	23235.2
173	5.78035	29929	5177717	13.1529	5.57205	543.496	23506.2
174	5.74713	30276	5268024	13.1909	5.58277	546.637	23778.7
175	5.71429	30625	5359375	13.2288	5.59344	549.779	24052.8
176	5.68182	30976	5451776	13.2665	5.60408	552.920	24328.5
177	5.64972	31329	5545233	13.3041	5.61467	556.062	24605.7
178	5.61798	31684	5639752	13.3417	5.62523	559.203	24884.6
179	5.58659	32041	5735339	13.3791	5.63574	562.345	25164.9
180	5.55556	32400	5832000	13.4164	5.64622	565.487	25446.9
181	5.52486	32761	5929741	13.4536	5.65665	568.628	25730.4
182	5.49451	33124	6028568	13.4907	5.66705	571.770	26015.5
183	5.46448	33489	6128487	13.5277	5.67741	574.911	26302.2
184	5.43478	33856	6229504	13.5647	5.68773	578.053	26590.4
185	5.40541	34225	6331625	13.6015	5.69802	581.195	26880.3
186	5.37634	34596	6434856	13.6382	5.70827	584.336	27171.6
187	5.34759	34969	6539203	13.6748	5.71848	587.478	27464.6
188	5.31915	35344	6644672	13.7113	5.72865	590.619	27759.1
189	5.29101	35721	6751269	13.7477	5.73879	593.761	28055.2
190	5.26316	36100	6859000	13.7840	5.74890	596.903	28352.9
191	5.23560	36481	6967871	13.8203	5.75897	600.044	28652.1
192	5.20833	36864	7077888	13.8564	5.76900	603.186	28952.9
193	5.18135	37249	7189057	13.8924	5.77900	606.327	29255.3
194	5.15464	37636	7301384	13.9284	5.78896	609.469	29559.3
195	5.12821	38025	7414875	13.9642	5.79889	612.611	29864.8
196	5.10204	38416	7529536	14.0000	5.80879	615.752	30171.9
197	5.07614	38809	7645373	14.0357	5.81865	618.894	30480.5
198	5.05051	39204	7762392	14.0712	5.82848	622.035	30790.8
199	5.02513	39601	7880599	14.1067	5.83827	625.177	31102.6
200	5.00000	40000	8000000	14.1421	5.84804	628.319	31415.9

NUMERICAL TABLE (Continued)

n	$1000\frac{1}{n}$	n^2	n^3	$\sqrt{n}$	$\sqrt[3]{n}$	Circum. of circle πn	Area of circle $\frac{1}{4}\pi n^2$
01	4.97512	40401	8120601	14.1774	5.85777	631.460	31730.9
02	4.95050	40804	8242408	14.2127	5.86746	634.602	32047.4
03	4.92611	41209	8365427	14.2478	5.87713	637.743	32365.5
04	4.90196	41616	8489664	14.2829	5.88677	640.885	32685.1
05	4.87805	42025	8615125	14.3178	5.89637	644.026	33006.4
06	4.85437	42436	8741816	14.3527	5.90594	647.168	33329.2
07	4.83092	42849	8869743	14.3875	5.91548	650.310	33653.5
08	4.80769	43264	8998912	14.4222	5.92499	653.451	33979.5
09	4.78469	43681	9129329	14.4568	5.93447	656.593	34307.0
10	4.76190	44100	9261000	14.4914	5.94392	659.734	34636.1
11	4.73934	44521	9393931	14.5258	5.95334	662.876	34966.7
12	4.71698	44944	9528128	14.5602	5.96273	666.018	35298.9
13	4.69484	45369	9663597	14.5945	5.97209	669.159	35632.7
14	4.67290	45796	9800344	14.6287	5.98142	672.301	35968.1
15	4.65116	46225	9938375	14.6629	5.99073	675.442	36305.0
16	4.62963	46656	10077696	14.6969	6.00000	678.584	36643.5
17	4.60829	47089	10218313	14.7309	6.00925	681.726	36983.6
18	4.58716	47524	10360232	14.7648	6.01846	684.867	37325.3
19	4.56621	47961	10503459	14.7986	6.02765	688.009	37668.5
20	4.54545	48400	10648000	14.8324	6.03681	691.150	38013.3
21	4.52489	48841	10793861	14.8661	6.04594	694.292	38359.6
22	4.50450	49284	10941048	14.8997	6.05505	697.434	38707.6
23	4.48430	49729	11089567	14.9332	6.06413	700.575	39057.1
24	4.46429	50176	11239424	14.9666	6.07318	703.717	39408.1
25	4.44444	50625	11390625	15.0000	6.08220	706.858	39760.8
26	4.42478	51076	11543176	15.0333	6.09120	710.000	40115.0
27	4.40529	51529	11697083	15.0665	6.10017	713.142	40470.8
28	4.38596	51984	11852352	15.0997	6.10911	716.283	40828.1
29	4.36681	52441	12008989	15.1327	6.11803	719.425	41187.1
30	4.34783	52900	12167000	15.1658	6.12693	722.566	41547.6
31	4.32900	53361	12326391	15.1987	6.13579	725.708	41909.6
32	4.31034	53824	12487168	15.2315	6.14463	728.849	42273.3
33	4.29185	54289	12649337	15.2643	6.15345	731.991	42638.5
34	4.27350	54756	12812904	15.2971	6.16224	735.133	43005.3
35	4.25532	55225	12977875	15.3297	6.17101	738.274	43373.6
36	4.23729	55696	13144256	15.3623	6.17975	741.416	43743.5
37	4.21941	56169	13312053	15.3948	6.18846	744.557	44115.0
38	4.20168	56644	13481272	15.4272	6.19715	747.699	44488.1
39	4.18410	57121	13651919	15.4596	6.20582	750.841	44862.7
40	4.16667	57600	13824000	15.4919	6.21447	753.982	45238.9
41	4.14938	58081	13997521	15.5242	6.22308	757.124	45616.7
42	4.13223	58564	14172488	15.5563	6.23168	760.265	45996.1
43	4.11523	59049	14348907	15.5885	6.24025	763.407	46377.0
44	4.09836	59536	14526784	15.6205	6.24880	766.549	46759.5
45	4.08163	60025	14706125	15.6525	6.25732	769.690	47143.5
46	4.06504	60516	14886936	15.6844	6.26583	772.832	47529.2
47	4.04858	61009	15069223	15.7162	6.27431	775.973	47916.4
48	4.03226	61504	15252992	15.7480	6.28276	779.115	48305.1
49	4.01606	62001	15438249	15.7797	6.29119	782.257	48695.5
50	4.00000	62500	15625000	15.8114	6.29961	785.398	49087.4

NUMERICAL TABLE (Continued)

n	$1000\frac{1}{n}$	n^2	n^3	$\sqrt{n}$	$\sqrt[3]{n}$	Circum. of circle πn	Area o circle $\frac{1}{4}\pi n^2$
251	3.98406	63001	15813251	15.8430	6.30799	788.540	49480.
252	3.96825	63504	16003008	15.8745	6.31636	791.681	49875.
253	3.95257	64009	16194277	15.9060	6.32470	794.823	50272.
254	3.93701	64516	16387064	15.9374	6.33303	797.965	50670.
255	3.92157	65025	16581375	15.9687	6.34133	801.106	51070.
256	3.90625	65536	16777216	16.0000	6.34960	804.248	51471.
257	3.89105	66049	16974593	16.0312	6.35786	807.389	51874.
258	3.87597	66564	17173512	16.0624	6.36610	810.531	52279.
259	3.86100	67081	17373979	16.0935	6.37431	813.672	52685.
260	3.84615	67600	17576000	16.1245	6.38250	816.814	53092.
261	3.83142	68121	17779581	16.1555	6.39068	819.956	53502.
262	3.81679	68644	17984728	16.1864	6.39883	823.097	53912.
263	3.80228	69169	18191447	16.2173	6.40696	826.239	54325.
264	3.78788	69696	18399744	16.2481	6.41507	829.380	54739.
265	3.77358	70225	18609625	16.2788	6.42316	832.522	55154.
266	3.75940	70756	18821096	16.3095	6.43123	835.664	55571.
267	3.74532	71289	19034163	16.3401	6.43928	838.805	55990.
268	3.73134	71824	19248832	16.3707	6.44731	841.947	56410.
269	3.71747	72361	19465109	16.4012	6.45531	845.088	56832.
270	3.70370	72900	19683000	16.4317	6.46330	848.230	57255.
271	3.69004	73441	19902511	16.4621	6.47127	851.372	57680.
272	3.67647	73984	20123648	16.4924	6.47922	854.513	58106.
273	3.66300	74529	20346417	16.5227	6.48715	857.655	58534.
274	3.64964	75076	20570824	16.5529	6.49507	860.796	58964.
275	3.63636	75625	20796875	16.5831	6.50296	863.938	59395.
276	3.62319	76176	21024576	16.6132	6.51083	867.080	59828.
277	3.61011	76729	21253933	16.6433	6.51868	870.221	60262.
278	3.59712	77284	21484952	16.6733	6.52652	873.363	60698.
279	3.58423	77841	21717639	16.7033	6.53434	876.504	61136.
280	3.57143	78400	21952000	16.7332	6.54213	879.646	61575.
281	3.55872	78961	22188041	16.7631	6.54991	882.788	62015.
282	3.54610	79524	22425768	16.7929	6.55767	885.929	62458.
283	3.53357	80089	22665187	16.8226	6.56541	889.071	62901.
284	3.52113	80656	22906304	16.8523	6.57314	892.212	63347.
285	3.50877	81225	23149125	16.8819	6.58084	895.354	63794.
286	3.49650	81796	23393656	16.9115	6.58853	898.495	64242.
287	3.48432	82369	23639903	16.9411	6.59620	901.637	64692.
288	3.47222	82944	23887872	16.9706	6.60385	904.779	65144.
289	3.46021	83521	24137569	17.0000	6.61149	907.920	65597.
290	3.44828	84100	24389000	17.0294	6.61911	911.062	66052.
291	3.43643	84681	24642171	17.0587	6.62671	914.203	66508.
292	3.42466	85264	24897088	17.0880	6.63429	917.345	66966.
293	3.41297	85849	25153757	17.1172	6.64185	920.487	67425.
294	3.40136	86436	25412184	17.1464	6.64940	923.628	67886.
295	3.38983	87025	25672375	17.1756	6.65693	926.770	68349.
296	3.37838	87616	25934336	17.2047	6.66444	929.911	68813.
297	3.36700	88209	26198073	17.2337	6.67194	933.053	69279.
298	3.35570	88804	26463592	17.2627	6.67942	936.195	69746.
299	3.34448	89401	26730899	17.2916	6.68688	939.336	70215.
300	3.33333	90000	27000000	17.3205	6.69433	942.478	70685.

NUMERICAL TABLE (Continued)

n	$1000\frac{1}{n}$	n^2	n^3	$\sqrt{n}$	$\sqrt[3]{n}$	Circum. of circle πn	Area of circle $\frac{1}{4}\pi n^2$
01	3.32226	90601	27270901	17.3494	6.70176	945.619	71157.9
02	3.31126	91204	27543608	17.3781	6.70917	948.761	71631.5
03	3.30033	91809	27818127	17.4069	6.71657	951.903	72106.6
04	3.28947	92416	28094464	17.4356	6.72395	955.044	72583.4
05	3.27869	93025	28372625	17.4642	6.73132	958.186	73061.7
06	3.26797	93636	28652616	17.4929	6.73866	961.327	73541.5
07	3.25733	94249	28934443	17.5214	6.74600	964.469	74023.0
08	3.24675	94864	29218112	17.5499	6.75331	967.611	74506.0
09	3.23625	95481	29503629	17.5784	6.76061	970.752	74990.6
10	3.22581	96100	29791000	17.6068	6.76790	973.894	75476.8
11	3.21543	96721	30080231	17.6352	6.77517	977.035	75964.5
12	3.20513	97344	30371328	17.6635	6.78242	980.177	76453.8
13.	3.19489	97969	30664297	17.6918	6.78966	983.318	76944.7
14	3.18471	98596	30959144	17.7200	6.79688	986.460	77437.1
15	3.17460	99225	31255875	17.7482	6.80409	989.602	77931.1
16	3.16456	99856	31554496	17.7764	6.81128	992.743	78426.7
17	3.15457	100489	31855013	17.8045	6.81846	995.885	78923.9
18	3.14465	101124	32157432	17.8326	6.82562	999.026	79422.6
19	3.13480	101761	32461759	17.8606	6.83277	1002.17	79922.9
20	3.12500	102400	32768000	17.8885	6.83990	1005.31	80424.8
21	3.11526	103041	33076161	17.9165	6.84702	1008.45	80928.2
22	3.10559	103684	33386248	17.9444	6.85412	1011.59	81433.2
23	3.09598	104329	33698267	17.9722	6.86121	1014.73	81939.8
24	3.08642	104976	34012224	18.0000	6.86829	1017.88	82448.0
25	3.07692	105625	34328125	18.0278	6.87534	1021.02	82957.7
26	3.06748	106276	34645976	18.0555	6.88239	1024.16	83469.0
27	3.05810	106929	34965783	18.0831	6.88942	1027.30	83981.8
28	3.04878	107584	35287552	18.1108	6.89643	1030.44	84496.3
29	3.03951	108241	35611289	18.1384	6.90344	1033.58	85012.3
30	3.03030	108900	35937000	18.1659	6.91042	1036.73	85529.9
31	3.02115	109561	36264691	18.1934	6.91740	1039.87	86049.0
32	3.01205	110224	36594368	18.2209	6.92436	1043.01	86569.7
33	3.00300	110889	36926037	18.2483	6.93130	1046.15	87092.0
34	2.99401	111556	37259704	18.2757	6.93823	1049.29	87615.9
35	2.98507	112225	37595375	18.3030	6.94515	1052.43	88141.3
36	2.97619	112896	37933056	18.3303	6.95205	1055.58	88668.3
37	2.96736	113569	38272753	18.3576	6.95894	1058.72	89196.9
38	2.95858	114244	38614472	18.3848	6.96582	1061.86	89727.0
39	2.94985	114921	38958219	18.4120	6.97268	1065.00	90258.7
40	2.94118	115600	39304000	18.4391	6.97953	1068.14	90792.0
41	2.93255	116281	39651821	18.4662	6.98637	1071.28	91326.9
42	2.92398	116964	40001688	18.4932	6.99319	1074.42	91863.3
43	2.91545	117649	40353607	18.5203	7.00000	1077.57	92401.3
44	2.90698	118336	40707584	18.5472	7.00680	1080.71	92940.9
45	2.89855	119025	41063625	18.5742	7.01358	1083.85	93482.0
46	2.89017	119716	41421736	18.6011	7.02035	1086.99	94024.7
47	2.88184	120409	41781923	18.6279	7.02711	1090.13	94569.0
48	2.87356	121104	42144192	18.6548	7.03385	1093.27	95114.9
49	2.86533	121801	42508549	18.6815	7.04058	1096.42	95662.3
50	2.85714	122500	42875000	18.7083	7.04730	1099.56	96211.3

NUMERICAL TABLE (Continued)

n	$1000\frac{1}{n}$	n^2	n^3	$\sqrt{n}$	$\sqrt[3]{n}$	Circum. of circle πn	Area of circle $\frac{1}{4}\pi n^2$
351	2.84900	123201	43243551	18.7350	7.05400	1102.70	96761.8
352	2.84091	123904	43614208	18.7617	7.06070	1105.84	97314.0
353	2.83286	124609	43986977	18.7883	7.06738	1108.98	97867.7
354	2.82486	125316	44361864	18.8149	7.07404	1112.12	98423.0
355	2.81690	126025	44738875	18.8414	7.08070	1115.27	98979.8
356	2.80899	126736	45118016	18.8680	7.08734	1118.41	99538.2
357	2.80112	127449	45499293	18.8944	7.09397	1121.55	100098.
358	2.79330	128164	45882712	18.9209	7.10059	1124.69	100660.
359	2.78552	128881	46268279	18.9473	7.10719	1127.83	101223.
360	2.77778	129600	46656000	18.9737	7.11379	1130.97	101788.
361	2.77008	130321	47045881	19.0000	7.12037	1134.11	102354.
362	2.76243	131044	47437928	19.0263	7.12694	1137.26	102922.
363	2.75482	131769	47832147	19.0526	7.13349	1140.40	103491.
364	2.74725	132496	48228544	19.0788	7.14004	1143.54	104062.
365	2.73973	133225	48627125	19.1050	7.14657	1146.68	104635.
366	2.73224	133956	49027896	19.1311	7.15309	1149.82	105209.
367	2.72480	134689	49430863	19.1572	7.15960	1152.96	105784.
368	2.71739	135424	49836032	19.1833	7.16610	1156.11	106362.
369	2.71003	136161	50243409	19.2094	7.17258	1159.25	106941.
370	2.70270	136900	50653000	19.2354	7.17905	1162.39	107521.
371	2.69542	137641	51064811	19.2614	7.18552	1165.53	108103.
372	2.68817	138384	51478848	19.2873	7.19197	1168.67	108687.
373	2.68097	139129	51895117	19.3132	7.19840	1171.81	109272.
374	2.67380	139876	52313624	19.3391	7.20483	1174.96	109858.
375	2.66667	140625	52734375	19.3649	7.21125	1178.10	110447.
376	2.65957	141376	53157376	19.3907	7.21765	1181.24	111036.
377	2.65252	142129	53582633	19.4165	7.22405	1184.38	111628.
378	2.64550	142884	54010152	19.4422	7.23043	1187.52	112221.
379	2.63852	143641	54439939	19.4679	7.23680	1190.66	112815.
380	2.63158	144400	54872000	19.4936	7.24316	1193.81	113411.
381	2.62467	145161	55306341	19.5192	7.24950	1196.95	114009.
382	2.61780	145924	55742968	19.5448	7.25584	1200.09	114608.
383	2.61097	146689	56181887	19.5704	7.26217	1203.23	115209.
384	2.60417	147456	56623104	19.5959	7.26848	1206.37	115812.
385	2.59740	148225	57066625	19.6214	7.27479	1209.51	116416.
386	2.59067	148996	57512456	19.6469	7.28108	1212.65	117021.
387	2.58398	149769	57960603	19.6723	7.28736	1215.80	117628.
388	2.57732	150544	58411072	19.6977	7.29363	1218.94	118237.
389	2.57069	151321	58863869	19.7231	7.29989	1222.08	118847.
390	2.56410	152100	59319000	19.7484	7.30614	1225.22	119459.
391	2.55754	152881	59776471	19.7737	7.31238	1228.36	120072.
392	2.55102	153664	60236288	19.7990	7.31861	1231.50	120687.
393	2.54453	154449	60698457	19.8242	7.32483	1234.65	121304.
394	2.53807	155236	61162984	19.8494	7.33104	1237.79	121922.
395	2.53165	156025	61629875	19.8746	7.33723	1240.93	122542.
396	2.52525	156816	62099136	19.8997	7.34342	1244.07	123163.
397	2.51889	157609	62570773	19.9249	7.34960	1247.21	123786.
398	2.51256	158404	63044792	19.9499	7.35576	1250.35	124410.
399	2.50627	159201	63521199	19.9750	7.36192	1253.50	125036.
400	2.50000	160000	64000000	20.0000	7.36806	1256.64	125664.

NUMERICAL TABLE (Continued)

n	$1000\frac{1}{n}$	n^2	n^3	$\sqrt{n}$	$\sqrt[3]{n}$	Circum. of circle πn	Area of circle $\frac{1}{4}\pi n^2$
1	2.49377	160801	64481201	20.0250	7.37420	1259.78	126293.
2	2.48756	161604	64964808	20.0499	7.38032	1262.92	126923.
3	2.48139	162409	65450827	20.0749	7.38644	1266.06	127556.
4	2.47525	163216	65939264	20.0998	7.39254	1269.20	128190.
5	2.46914	164025	66430125	20.1246	7.39864	1272.35	128825.
6	2.46305	164836	66923416	20.1494	7.40472	1275.49	129462.
7	2.45700	165649	67419143	20.1742	7.41080	1278.63	130100.
8	2.45098	166464	67917312	20.1990	7.41686	1281.77	130741.
9	2.44499	167281	68417929	20.2237	7.42291	1284.91	131382.
0	2.43902	168100	68921000	20.2485	7.42896	1288.05	132025.
1	2.43309	168921	69426531	20.2731	7.43499	1291.19	132670.
2	2.42718	169744	69934528	20.2978	7.44102	1294.34	133317.
3	2.42131	170569	70444997	20.3224	7.44703	1297.48	133965.
4	2.41546	171396	70957944	20.3470	7.45304	1300.62	134614.
5	2.40964	172225	71473375	20.3715	7.45904	1303.76	135265.
6	2.40385	173056	71991296	20.3961	7.46502	1306.90	135918.
7	2.39808	173889	72511713	20.4206	7.47100	1310.04	136572.
8	2.39234	174724	73034632	20.4450	7.47697	1313.19	137228.
9	2.38663	175561	73560059	20.4695	7.48292	1316.33	137885.
0	2.38095	176400	74088000	20.4939	7.48887	1319.47	138544.
1	2.37530	177241	74618461	20.5183	7.49481	1322.61	139205.
2	2.36967	178084	75151448	20.5426	7.50074	1325.75	139867.
3	2.36407	178929	75686967	20.5670	7.50666	1328.89	140531.
4	2.35849	179776	76225024	20.5913	7.51257	1332.04	141196.
5	2.35294	180625	76765625	20.6155	7.51847	1335.18	141863.
6	2.34742	181476	77308776	20.6398	7.52437	1338.32	142531.
7	2.34192	182329	77854483	20.6640	7.53025	1341.46	143201.
8	2.33645	183184	78402752	20.6882	7.53612	1344.60	143872.
9	2.33100	184041	78953589	20.7123	7.54199	1347.74	144545.
0	2.32558	184900	79507000	20.7364	7.54784	1350.88	145220.
1	2.32019	185761	80062991	20.7605	7.55369	1354.03	145896.
2	2.31481	186624	80621568	20.7846	7.55953	1357.17	146574.
3	2.30947	187489	81182737	20.8087	7.56535	1360.31	147254.
4	2.30415	188356	81746504	20.8327	7.57117	1363.45	147934.
5	2.29885	189225	82312875	20.8567	7.57698	1366.59	148617.
6	2.29358	190096	82881856	20.8806	7.58279	1369.73	149301.
7	2.28833	190969	83453453	20.9045	7.58858	1372.88	149987.
8	2.28311	191844	84027672	20.9284	7.59436	1376.02	150674.
9	2.27790	192721	84604519	20.9523	7.60014	1379.16	151363.
0	2.27273	193600	85184000	20.9762	7.60590	1382.30	152053.
1	2.26757	194481	85766121	21.0000	7.61166	1385.44	152745.
2	2.26244	195364	86350888	21.0238	7.61741	1388.58	153439.
3	2.25734	196249	86938307	21.0476	7.62315	1391.73	154134.
4	2.25225	197136	87528384	21.0713	7.62888	1394.87	154830.
5	2.24719	198025	88121125	21.0950	7.63461	1398.01	155528.
6	2.24215	198916	88716563	21.1187	7.64032	1401.15	156228.
7	2.23714	199809	89314623	21.1424	7.64603	1404.29	156930.
8	2.23214	200704	89915392	21.1660	7.65172	1407.43	157633.
9	2.22717	201601	90518849	21.1896	7.65741	1410.58	158337.
0	2.22222	202500	91125000	21.2132	7.66309	1413.72	159043.

NUMERICAL TABLE (Continued)

n	$1000\frac{1}{n}$	n^2	n^3	$\sqrt{n}$	$\sqrt[3]{n}$	Circum. of circle πn	Area of circle $\frac{1}{4}\pi n^2$
451	2.21729	203401	91733851	21.2368	7.66877	1416.86	159751
452	2.21239	204304	92345408	21.2603	7.67443	1420.00	160460
453	2.20751	205209	92959677	21.2838	7.68009	1423.14	161171
454	2.20264	206116	93576664	21.3073	7.68573	1426.28	161883
455	2.19780	207025	94196375	21.3307	7.69137	1429.42	162597
456	2.19298	207936	94818816	21.3542	7.69700	1432.57	163313
457	2.18818	208849	95443993	21.3776	7.70262	1435.71	164030
458	2.18341	209764	96071912	21.4009	7.70824	1438.85	164748
459	2.17865	210681	96702579	21.4243	7.71384	1441.99	165468
460	2.17391	211600	97336000	21.4476	7.71944	1445.13	166190
461	2.16920	212521	97972181	21.4709	7.72503	1448.27	166914
462	2.16450	213444	98611128	21.4942	7.73061	1451.42	167639
463	2.15983	214369	99252847	21.5174	7.73619	1454.56	168365
464	2.15517	215296	99897344	21.5407	7.74175	1457.70	169093
465	2.15054	216225	100544625	21.5639	7.74731	1460.84	169823
466	2.14592	217156	101194696	21.5870	7.75286	1463.98	170554
467	2.14133	218089	101847563	21.6102	7.75840	1467.12	171287
468	2.13675	219024	102503232	21.6333	7.76394	1470.27	172021
469	2.13220	219961	103161709	21.6564	7.76946	1473.41	172757
470	2.12766	220900	103823000	21.6795	7.77498	1476.55	173494
471	2.12314	221841	104487111	21.7025	7.78049	1479.69	174234
472	2.11864	222784	105154048	21.7256	7.78599	1482.83	174974
473	2.11416	223729	105823817	21.7486	7.79149	1485.97	175716
474	2.10970	224676	106496424	21.7715	7.79697	1489.11	176460
475	2.10526	225625	107171875	21.7945	7.80245	1492.26	177205
476	2.10084	226576	107850176	21.8174	7.80793	1495.40	177952
477	2.09644	227529	108531333	21.8403	7.81339	1498.54	178701
478	2.09205	228484	109215352	21.8632	7.81885	1501.68	179451
479	2.08768	229441	109902239	21.8861	7.82429	1504.82	180203
480	2.08333	230400	110592000	21.9089	7.82974	1507.96	180956
481	2.07900	231361	111284641	21.9317	7.83517	1511.11	181711
482	2.07469	232324	111980168	21.9545	7.84059	1514.25	182467
483	2.07039	233289	112678587	21.9773	7.84601	1517.39	183225
484	2.06612	234256	113379904	22.0000	7.85142	1520.53	183984
485	2.06186	235225	114084125	22.0227	7.85683	1523.67	184745
486	2.05761	236196	114791256	22.0454	7.86222	1526.81	185508
487	2.05339	237169	115501303	22.0681	7.86761	1529.96	186272
488	2.04918	238144	116214272	22.0907	7.87299	1533.10	187038
489	2.04499	239121	116930169	22.1133	7.87837	1536.24	187805
490	2.04082	240100	117649000	22.1359	7.88374	1539.38	188574
491	2.03666	241081	118370771	22.1585	7.88909	1542.52	189345
492	2.03252	242064	119095488	22.1811	7.89445	1545.66	190117
493	2.02840	243049	119823157	22.2036	7.89979	1548.81	190890
494	2.02429	244036	120553784	22.2261	7.90513	1551.95	191665
495	2.02020	245025	121287375	22.2486	7.91046	1555.09	192442
496	2.01613	246016	122023936	22.2711	7.91578	1558.23	193221
497	2.01207	247009	122763473	22.2935	7.92110	1561.37	194000
498	2.00803	248004	123505992	22.3159	7.92641	1564.51	194782
499	2.00401	249001	124251499	22.3383	7.93171	1567.65	195565
500	2.00000	250000	125000000	22.3607	7.93701	1570.80	196350

NUMERICAL TABLE (Continued)

n	$1000\frac{1}{n}$	n^2	n^3	$\sqrt{n}$	$\sqrt[3]{n}$	Circum. of circle πn	Area of circle $\frac{1}{4}\pi n^2$
01	1.99601	251001	125751501	22.3830	7.94229	1573.94	197136
02	1.99203	252004	126506008	22.4054	7.94757	1577.80	197923
03	1.98807	253009	127263527	22.4277	7.95285	1580.22	198713
04	1.98413	254016	128024064	22.4499	7.95811	1583.36	199504
05	1.98020	255025	128787625	22.4722	7.96337	1586.50	200296
06	1.97628	256036	129554216	22.4944	7.96863	1589.65	201090
07	1.97239	257049	130323843	22.5167	7.97387	1592.79	201886
08	1.96850	258064	131096512	22.5389	7.97911	1595.93	202683
09	1.96464	259081	131872229	22.5610	7.98434	1599.07	203482
10	1.96078	260100	132651000	22.5832	7.98957	1602.21	204282
11	1.95695	261121	133432831	22.6053	7.99479	1605.35	205084
12	1.95312	262144	134217728	22.6274	8.00000	1608.50	205887
13	1.94932	263169	135005697	22.6495	8.00520	1611.64	206692
14	1.94553	264196	135796744	22.6716	8.01040	1614.78	207499
15	1.94175	265225	136590875	22.6936	8.01559	1617.92	208307
16	1.93798	266256	137388096	22.7156	8.02078	1621.06	209117
17	1.93424	267289	138188413	22.7376	8.02596	1624.20	209928
18	1.93050	268324	138991832	22.7596	8.03113	1627.34	210741
19	1.92678	269361	139798359	22.7816	8.03629	1630.49	211556
20	1.92308	270400	140608000	22.8035	8.04145	1633.63	212372
21	1.91939	271441	141420761	22.8254	8.04660	1636.77	213189
22	1.91571	272484	142236648	22.8473	8.05175	1639.91	214008
23	1.91205	273529	143055667	22.8692	8.05689	1643.05	214829
24	1.90840	274576	143877824	22.8910	8.06202	1646.19	215651
25	1.90476	275625	144703125	22.9129	8.06714	1649.34	216475
26	1.90114	276676	145531576	22.9347	8.07226	1652.48	217301
27	1.89753	277729	146363183	22.9565	8.07737	1655.62	218128
28	1.89394	278784	147197952	22.9783	8.08248	1658.76	218956
29	1.89036	279841	148035889	23.0000	8.08758	1661.90	219787
30	1.88679	280900	148877000	23.0217	8.09267	1665.04	220618
31	1.88324	281961	149721291	23.0434	8.09776	1668.19	221452
32	1.87970	283024	150568768	23.0651	8.10284	1671.33	222287
33	1.87617	284089	151419437	23.0868	8.10791	1674.47	223123
34	1.87266	285156	152273304	23.1084	8.11298	1677.61	223961
35	1.86916	286225	153130375	23.1301	8.11804	1680.75	224801
36	1.86567	287296	153990656	23.1517	8.12310	1683.89	225642
37	1.86220	288369	154854153	23.1733	8.12814	1687.04	226484
38	1.85874	289444	155720872	23.1948	8.13319	1690.18	227329
39	1.85529	290521	156590819	23.2164	8.13822	1693.32	228175
40	1.85185	291600	157464000	23.2379	8.14325	1696.46	229022
41	1.84843	292681	158340421	23.2594	8.14828	1699.60	229871
42	1.84502	293764	159220088	23.2809	8.15329	1702.74	230722
43	1.84162	294849	160103007	23.3024	8.15831	1705.88	231574
44	1.83824	295936	160989184	23.3238	8.16331	1709.03	232428
45	1.83486	297025	161878625	23.3452	8.16831	1712.17	233283
46	1.83150	298116	162771336	23.3666	8.17330	1715.31	234140
47	1.82815	299209	163667323	23.3880	8.17829	1718.45	234998
48	1.82482	300304	164566592	23.4094	8.18327	1721.59	235858
49	1.82149	301401	165469149	23.4307	8.18824	1724.73	236720
50	1.81818	302500	166375000	23.4521	8.19321	1727.88	237583

NUMERICAL TABLE (Continued)

n	$1000\frac{1}{n}$	n^2	n^3	$\sqrt{n}$	$\sqrt[3]{n}$	Circum. of circle πn	Area of circle $\frac{1}{4}\pi n^2$
551	1.81488	303601	167284151	23.4734	8.19818	1731.02	238448
552	1.81159	304704	168196608	23.4947	8.20313	1734.16	239314
553	1.80832	305809	169112377	23.5160	8.20808	1737.30	240182
554	1.80505	306916	170031464	23.5372	8.21303	1740.44	241051
555	1.80180	308025	170953875	23.5584	8.21797	1743.58	241922
556	1.79856	309136	171879616	23.5797	8.22290	1746.73	242795
557	1.79533	310249	172808693	23.6008	8.22783	1749.87	243669
558	1.79211	311364	173741112	23.6220	8.23275	1753.01	244545
559	1.78891	312481	174676879	23.6432	8.23766	1756.15	245422
560	1.78571	313600	175616000	23.6643	8.24257	1759.29	246301
561	1.78253	314721	176558481	23.6854	8.24747	1762.43	247181
562	1.77936	315844	177504328	23.7065	8.25237	1765.58	248063
563	1.77620	316969	178453547	23.7276	8.25726	1768.72	248947
564	1.77305	318096	179406144	23.7487	8.26215	1771.86	249832
565	1.76991	319225	180362125	23.7697	8.26703	1775.00	250719
566	1.76678	320356	181321496	23.7908	8.27190	1778.14	251607
567	1.76367	321489	182284263	23.8118	8.27677	1781.28	252497
568	1.76056	322624	183250432	23.8328	8.28164	1784.42	253388
569	1.75747	323761	184220009	23.8537	8.28649	1787.57	254281
570	1.75439	324900	185193000	23.8747	8.29134	1790.71	255176
571	1.75131	326041	186169411	23.8956	8.29619	1793.85	256072
572	1.74825	327184	187149248	23.9165	8.30103	1796.99	256970
573	1.74520	328329	188132517	23.9374	8.30587	1800.13	257869
574	1.74216	329476	189119224	23.9583	8.31069	1803.27	258770
575	1.73913	330625	190109375	23.9792	8.31552	1806.42	259672
576	1.73611	331776	191102976	24.0000	8.32034	1809.56	260576
577	1.73310	332929	192100033	24.0208	8.32515	1812.70	261482
578	1.73010	334084	193100552	24.0416	8.32995	1815.84	262389
579	1.72712	335241	194104539	24.0624	8.33476	1818.98	263298
580	1.72414	336400	195112000	24.0832	8.33955	1822.12	264208
581	1.72117	337561	196122941	24.1039	8.34434	1825.27	265120
582	1.71821	338724	197137368	24.1247	8.34913	1828.41	266033
583	1.71527	339889	198155287	24.1454	8.35390	1831.55	266948
584	1.71233	341056	199176704	24.1661	8.35868	1834.69	267865
585	1.70940	342225	200201625	24.1868	8.36345	1837.83	268783
586	1.70648	343396	201230056	24.2074	8.36821	1840.97	269703
587	1.70358	344569	202262003	24.2281	8.37297	1844.11	270624
588	1.70068	345744	203297472	24.2487	8.37772	1847.26	271547
589	1.69779	346921	204336469	24.2693	8.38247	1850.40	272471
590	1.69492	348100	205379000	24.2899	8.38721	1853.54	273397
591	1.69205	349281	206425071	24.3105	8.39194	1856.68	274325
592	1.68919	350464	207474688	24.3311	8.39667	1859.82	275254
593	1.68634	351649	208527857	24.3516	8.40140	1862.96	276184
594	1.68350	352836	209584584	24.3721	8.40612	1866.11	277117
595	1.68067	354025	210644875	24.3926	8.41083	1869.25	278051
596	1.67785	355216	211708736	24.4131	8.41554	1872.39	278986
597	1.67504	356409	212776173	24.4336	8.42025	1875.53	279923
598	1.67224	357604	213847192	24.4540	8.42494	1878.67	280862
599	1.66945	358801	214921799	24.4745	8.42964	1881.81	281802
600	1.66667	360000	216000000	24.4949	8.43433	1884.96	282743

NUMERICAL TABLE (Continued)

n	$1000\frac{1}{n}$	n^2	n^3	$\sqrt{n}$	$\sqrt[3]{n}$	Circum. of circle πn	Area of circle $\frac{1}{4}\pi n^2$
01	1.66389	361201	217081801	24.5153	8.43901	1888.10	283687
02	1.66113	362404	218167208	24.5357	8.44369	1891.24	284631
03	1.65837	363609	219256227	24.5561	8.44836	1894.38	285578
04	1.65563	364816	220348864	24.5764	8.45303	1897.52	286526
05	1.65289	366025	221445125	24.5967	8.45769	1900.66	287475
06	1.65017	367236	222545016	24.6171	8.46235	1903.81	288426
07	1.64745	368449	223648543	24.6374	8.46700	1906.95	289379
08	1.64474	369664	224755712	24.6577	8.47165	1910.09	290333
09	1.64204	370881	225866529	24.6779	8.47629	1913.23	291289
10	1.63934	372100	226981000	24.6982	8.48093	1916.37	292247
11	1.63666	373321	228099131	24.7184	8.48556	1919.51	293205
12	1.63399	374544	229220928	24.7386	8.49018	1922.65	294166
13	1.63132	375769	230346397	24.7588	8.49481	1925.80	295128
14	1.62866	376996	231475544	24.7790	8.49942	1928.94	296092
15	1.62602	378225	232608375	24.7992	8.50403	1932.08	297057
16	1.62338	379456	233744896	24.8193	8.50864	1935.22	298024
17	1.62075	380689	234885113	24.8395	8.51324	1938.36	298992
18	1.61812	381924	236029032	24.8596	8.51784	1941.50	299962
19	1.61551	383161	237176659	24.8797	8.52243	1944.65	300934
20	1.61290	384400	238328000	24.8998	8.52702	1947.79	301907
21	1.61031	385641	239483061	24.9199	8.53160	1950.93	302882
22	1.60772	386884	240641848	24.9398	8.53618	1954.07	303858
23	1.60514	388129	241804367	24.9600	8.54075	1957.21	304836
24	1.60256	389376	242970624	24.9800	8.54532	1960.35	305815
25	1.60000	390625	244140625	25.0000	8.54988	1963.50	306796
26	1.59744	391876	245314376	25.0200	8.55444	1966.64	307779
27	1.59490	393129	246491883	25.0400	8.55899	1969.78	308763
28	1.59236	394384	247673152	25.0599	8.56354	1972.92	309748
29	1.58983	395641	248858189	25.0799	8.56808	1976.06	310736
30	1.58730	396900	250047000	25.0998	8.57262	1979.20	311725
31	1.58479	398161	251239591	25.1197	8.57715	1982.35	312715
32	1.58228	399424	252435968	25.1396	8.58168	1985.49	313707
33	1.57978	400689	253636137	25.1595	8.58620	1988.63	314700
34	1.57729	401956	254840104	25.1794	8.59072	1991.77	315696
35	1.57480	403225	256047875	25.1992	8.59524	1994.91	316692
36	1.57233	404496	257259456	25.2190	8.59975	1998.05	317690
37	1.56986	405769	258474853	25.2389	8.60425	2001.19	318690
38	1.56740	407044	259694072	25.2587	8.60875	2004.34	319692
39	1.56495	408321	260917119	25.2784	8.61325	2007.48	320695
40	1.56250	409600	262144000	25.2982	8.61774	2010.62	321699
41	1.56006	410881	263374721	25.3180	8.62222	2013.76	322705
42	1.55763	412164	264609288	25.3377	8.62671	2016.90	323713
43	1.55521	413449	265847707	25.3574	8.63118	2020.04	324722
44	1.55280	414736	267089984	25.3772	8.63566	2023.19	325733
45	1.55039	416025	268336125	25.3969	8.64012	2026.33	326745
46	1.54799	417316	269586136	25.4165	8.64459	2029.47	327759
47	1.54560	418609	270840023	25.4362	8.64904	2032.61	328775
48	1.54321	419904	272097792	25.4558	8.65350	2035.75	329792
49	1.54083	421201	273359449	25.4755	8.65795	2038.89	330810
50	1.53846	422500	274625000	25.4951	8.66239	2042.04	331831

NUMERICAL TABLE (Continued)

n	$1000\frac{1}{n}$	n^2	n^3	$\sqrt{n}$	$\sqrt[3]{n}$	Circum. of circle πn	Area of circle $\frac{1}{4}\pi n^2$
651	1.53610	423801	275894451	25.5147	8.66683	2045.18	332853
652	1.53374	425104	277167808	25.5343	8.67127	2048.32	333876
653	1.53139	426409	278445077	25.5539	8.67570	2051.46	334901
654	1.52905	427716	279726264	25.5734	8.68012	2054.60	335927
655	1.52672	429025	281011375	25.5930	8.68455	2057.74	336955
656	1.52439	430336	282300416	25.6125	8.68896	2060.88	337985
657	1.52207	431649	283593393	25.6320	8.69338	2064.03	339016
658	1.51976	432964	284890312	25.6515	8.69778	2067.17	340049
659	1.51745	434281	286191179	25.6710	8.70219	2070.31	341084
660	1.51515	435600	287496000	25.6905	8.70659	2073.45	342119
661	1.51286	436921	288804781	25.7099	8.71098	2076.59	343157
662	1.51057	438244	290117528	25.7294	8.71537	2079.73	344196
663	1.50830	439569	291434247	25.7488	8.71976	2082.88	345237
664	1.50602	440896	292754944	25.7682	8.72414	2086.02	346279
665	1.50376	442225	294079625	25.7876	8.72852	2089.16	347323
666	1.50150	443556	295408296	25.8070	8.73289	2092.30	348368
667	1.49925	444889	296740963	25.8263	8.73726	2095.44	349415
668	1.49701	446224	298077632	25.8457	8.74162	2098.58	350464
669	1.49477	447561	299418309	25.8650	8.74598	2101.73	351514
670	1.49254	448900	300763000	25.8844	8.75034	2104.87	352565
671	1.49031	450241	302111711	25.9037	8.75469	2108.01	353618
672	1.48810	451584	303464448	25.9230	8.75904	2111.15	354673
673	1.48588	452929	304821217	25.9422	8.76338	2114.29	355730
674	1.48368	454276	306182024	25.9615	8.76772	2117.43	356788
675	1.48148	455625	307546875	25.9808	8.77205	2120.58	357847
676	1.47929	456976	308915776	26.0000	8.77638	2123.72	358908
677	1.47710	458329	310288733	26.0192	8.78071	2126.86	359971
678	1.47493	459684	311665752	26.0384	8.78503	2130.00	361035
679	1.47275	461041	313046839	26.0576	8.78935	2133.14	362101
680	1.47059	462400	314432000	26.0768	8.79366	2136.28	363168
681	1.46843	463761	315821241	26.0960	8.79797	2139.42	364237
682	1.46628	465124	317214568	26.1151	8.80227	2142.57	365308
683	1.46413	466489	318611987	26.1343	8.80657	2145.71	366380
684	1.46199	467856	320013504	26.1534	8.81087	2148.85	367453
685	1.45985	469225	321419125	26.1725	8.81516	2151.99	368528
686	1.45773	470596	322828856	26.1916	8.81945	2155.13	369605
687	1.45560	471969	324242703	26.2107	8.82373	2158.27	370684
688	1.45349	473344	325660672	26.2298	8.82801	2161.42	371764
689	1.45138	474721	327082769	26.2488	8.83228	2164.56	372845
690	1.44928	476100	328509000	26.2679	8.83656	2167.70	373928
691	1.44718	477481	329939371	26.2869	8.84082	2170.84	375013
692	1.44509	478864	331373888	26.3059	8.84509	2173.98	376099
693	1.44300	480249	332812557	26.3249	8.84934	2177.12	377187
694	1.44092	481636	334255384	26.3439	8.85360	2180.27	378276
695	1.43885	483025	335702375	26.3629	8.85785	2183.41	379367
696	1.43678	484416	337153536	26.3818	8.86210	2186.55	380459
697	1.43472	485809	338608873	26.4008	8.86634	2189.69	381554
698	1.43266	487204	340068392	26.4197	8.87058	2192.83	382649
699	1.43062	488601	341532099	26.4386	8.87481	2195.97	383746
700	1.42857	490000	343000000	26.4575	8.87904	2199.11	384845

NUMERICAL TABLE (Continued)

n	$1000\frac{1}{n}$	n^2	n^3	$\sqrt{n}$	$\sqrt[3]{n}$	Circum. of circle πn	Area of circle $\frac{1}{4}\pi n^2$
01	1.42653	491401	344472101	26.4764	8.88327	2202.26	385945
02	1.42450	492804	345948408	26.4953	8.88749	2205.40	387047
03	1.42248	494209	347428927	26.5141	8.89171	2208.54	388151
04	1.42045	495616	348913664	26.5330	8.89592	2211.68	389256
05	1.41844	497025	350402625	26.5518	8.90013	2214.82	390363
06	1.41643	498436	351895816	26.5707	8.90434	2217.96	391471
07	1.41443	499849	353393243	26.5895	8.90854	2221.11	392580
08	1.41243	501264	354894912	26.6083	8.91274	2224.25	393692
09	1.41044	502681	356400829	26.6271	8.91693	2227.39	394805
10	1.40845	504100	357911000	26.6458	8.92112	2230.53	395919
11	1.40647	505521	359425431	26.6646	8.92531	2233.67	397035
12	1.40449	506944	360944128	26.6833	8.92949	2236.81	398153
13	1.40252	508369	362467097	26.7021	8.93367	2239.96	399272
14	1.40056	509796	363994344	26.7208	8.93784	2243.10	400393
15	1.39860	511225	365525875	26.7395	8.94201	2246.24	401515
16	1.39665	512656	367061696	26.7582	8.94618	2249.38	402639
17	1.39470	514089	368601813	26.7769	8.95034	2252.52	403765
18	1.39276	515524	370146232	26.7955	8.95450	2255.66	404892
19	1.39082	516961	371694959	26.8142	8.95866	2258.81	406020
20	1.38889	518400	373248000	26.8328	8.96281	2261.95	407150
21	1.38696	519841	374805361	26.8514	8.96696	2265.09	408282
22	1.38504	521284	376367048	26.8701	8.97110	2268.23	409416
23	1.38313	522729	377933067	26.8887	8.97524	2271.37	410550
24	1.38122	524176	379503424	26.9072	8.97938	2274.51	411687
25	1.37931	525625	381078125	26.9258	8.98351	2277.65	412825
26	1.37741	527076	382657176	26.9444	8.98764	2280.80	413965
27	1.37552	528529	384240583	26.9629	8.99176	2283.94	415106
28	1.37363	529984	385828352	26.9815	8.99588	2287.08	416248
29	1.37174	531441	387420489	27.0000	9.00000	2290.22	417393
30	1.36986	532900	389017000	27.0185	9.00411	2293.36	418539
31	1.36799	534361	390617891	27.0370	9.00822	2296.50	419686
32	1.36612	535824	392223168	27.0555	9.01233	2299.65	420835
33	1.36426	537289	393832837	27.0740	9.01643	2302.79	421986
34	1.36240	538756	395446904	27.0924	9.02053	2305.93	423138
35	1.36054	540225	397065375	27.1109	9.02462	2309.07	424292
36	1.35870	541696	398688256	27.1293	9.02871	2312.21	425447
37	1.35685	543169	400315553	27.1477	9.03280	2315.35	426604
38	1.35501	544644	401947272	27.1662	9.03689	2318.50	427762
39	1.35318	546121	403583419	27.1846	9.04097	2321.64	428922
40	1.35135	547600	405224000	27.2029	9.04504	2324.78	430084
41	1.34953	549081	406869021	27.2213	9.04911	2327.92	431247
42	1.34771	550564	408518488	27.2397	9.05318	2331.06	432412
43	1.34590	552049	410172407	27.2580	9.05725	2334.20	433578
44	1.34409	553536	411830784	27.2764	9.06131	2337.34	434746
45	1.34228	555025	413493625	27.2947	9.06537	2340.49	435916
46	1.34048	556516	415160936	27.3130	9.06942	2343.63	437087
47	1.33869	558009	416832723	27.3313	9.07347	2346.77	438259
48	1.33690	559504	418508992	27.3496	9.07752	2349.91	439433
49	1.33511	561001	420189749	27.3679	9.08156	2353.05	440609
50	1.33333	562500	421875000	27.3861	9.08560	2356.19	441786

NUMERICAL TABLE (Continued)

n	$1000\frac{1}{n}$	n^2	n^3	$\sqrt{n}$	$\sqrt[3]{n}$	Circum. of circle πn	Area of circle $\frac{1}{4}\pi n^2$
751	1.33156	564001	423564751	27.4044	9.08964	2359.34	442965
752	1.32979	565504	425259008	27.4226	9.09367	2362.48	444146
753	1.32802	567009	426957777	27.4408	9.09770	2365.62	445328
754	1.32626	568516	428661064	27.4591	9.10173	2368.76	446511
755	1.32450	570025	430368875	27.4773	9.10575	2371.90	447697
756	1.32275	571536	432081216	27.4955	9.10977	2375.04	448883
757	1.32100	573049	433798093	27.5136	9.11378	2378.19	450072
758	1.31926	574564	435519512	27.5318	9.11779	2381.33	451262
759	1.31752	576081	437245479	27.5500	9.12180	2384.47	452453
760	1.31579	577600	438976000	27.5681	9.12581	2387.61	453646
761	1.31406	579121	440711081	27.5862	9.12981	2390.75	454841
762	1.31234	580644	442450728	27.6043	9.13380	2393.89	456037
763	1.31062	582169	444194947	27.6225	9.13780	2397.04	457234
764	1.30890	583696	445943744	27.6405	9.14179	2400.18	458434
765	1.30719	585225	447697125	27.6586	9.14577	2403.32	459635
766	1.30548	586756	449455096	27.6767	9.14976	2406.46	460837
767	1.30378	588289	451217663	27.6948	9.15374	2409.60	462041
768	1.30208	589824	452984832	27.7128	9.15771	2412.74	463247
769	1.30039	591361	454756609	27.7308	9.16169	2415.88	464454
770	1.29870	592900	456533000	27.7489	9.16566	2419.03	465663
771	1.29702	594441	458314011	27.7669	9.16962	2422.17	466873
772	1.29534	595984	460099648	27.7849	9.17359	2425.31	468085
773	1.29366	597529	461889917	27.8029	9.17754	2428.45	469298
774	1.29199	599076	463684824	27.8209	9.18150	2431.59	470513
775	1.29032	600625	465484375	27.8388	9.18545	2434.73	471730
776	1.28866	602176	467288576	27.8568	9.18940	2437.88	472948
777	1.28700	603729	469097433	27.8747	9.19335	2441.02	474168
778	1.28535	605284	470910952	27.8927	9.19729	2444.16	475389
779	1.28370	606841	472729139	27.9106	9.20123	2447.30	476612
780	1.28205	608400	474552000	27.9285	9.20516	2450.44	477836
781	1.28041	609961	476379541	27.9464	9.20910	2453.58	479062
782	1.27877	611524	478211768	27.9643	9.21302	2456.73	480290
783	1.27714	613089	480048687	27.9821	9.21695	2459.87	481519
784	1.27551	614656	481890304	28.0000	9.22087	2463.01	482750
785	1.27389	616225	483736625	28.0179	9.22479	2466.15	483982
786	1.27226	617796	485587656	28.0357	9.22871	2469.29	485216
787	1.27065	619369	487443403	28.0535	9.23262	2472.43	486451
788	1.26904	620944	489303872	28.0713	9.23653	2475.58	487688
789	1.26743	622521	491169069	28.0891	9.24043	2478.72	488927
790	1.26582	624100	493039000	28.1069	9.24434	2481.86	490167
791	1.26422	625681	494913671	28.1247	9.24823	2485.00	491409
792	1.26263	627264	496793088	28.1425	9.25213	2488.14	492652
793	1.26103	628849	498677257	28.1603	9.25602	2491.28	493897
794	1.25945	630436	500566184	28.1780	9.25991	2494.42	495143
795	1.25786	632025	502459875	28.1957	9.26380	2497.57	496391
796	1.25628	633616	504358336	28.2135	9.26768	2500.71	497641
797	1.25471	635209	506261573	28.2312	9.27156	2503.85	498892
798	1.25313	636812	508169592	28.2489	9.27544	2506.99	500145
799	1.25156	638401	510082399	28.2666	9.27931	2510.13	501399
800	1.25000	640000	512000000	28.2843	9.28318	2513.27	502655

NUMERICAL TABLE (Continued)

$1000\frac{1}{n}$	n^2	n^3	$\sqrt{n}$	$\sqrt[3]{n}$	Circum. of circle πn	Area of circle $\frac{1}{4}\pi n^2$
1.24844	641601	513922401	28.3019	9.28704	2516.42	503912
1.24688	643204	515849608	28.3196	9.29091	2519.56	505171
1.24533	644809	517781627	28.3373	9.29477	2522.70	506432
1.24378	646416	519718464	28.3549	9.29862	2525.84	507694
1.24224	648025	521660125	28.3725	9.30248	2528.98	508958
1.24069	649636	523606616	28.3901	9.30633	2532.12	510223
1.23916	651249	525557943	28.4077	9.31018	2535.27	511490
1.23762	652864	527514112	28.4253	9.31402	2538.41	512758
1.23609	654481	529475129	28.4429	9.31786	2541.55	514028
1.23457	656100	531441000	28.4605	9.32170	2544.69	515300
1.23305	657721	533411731	28.4781	9.32553	2547.83	516573
1.23153	659344	535387328	28.4956	9.32936	2550.97	517848
1.23001	660969	537367797	28.5132	9.33319	2554.11	519124
1.22850	662596	539353144	28.5307	9.33702	2557.26	520402
1.22699	664225	541343375	28.5482	9.34084	2560.40	521681
1.22549	665856	543338496	28.5657	9.34466	2563.54	522962
1.22399	667489	545338513	28.5832	9.34847	2566.68	524245
1.22249	669124	547343432	28.6007	9.35229	2569.82	525529
1.22100	670761	549353259	28.6182	9.35610	2572.96	526814
1.21951	672400	551368000	28.6356	9.35990	2576.11	528102
1.21803	674041	553387661	28.6531	9.36370	2579.25	529391
1.21655	675684	555412248	28.6705	9.36751	2582.39	530681
1.21507	677329	557441767	28.6880	9.37130	2585.53	531973
1.21359	678976	559476224	28.7054	9.37510	2588.67	533267
1.21212	680625	561515625	28.7228	9.37889	2591.81	534562
1.21065	682276	563559976	28.7402	9.38268	2594.96	535858
1.20919	683929	565609283	28.7576	9.38646	2598.10	537157
1.20773	685584	567663552	28.7750	9.39024	2601.24	538456
1.20627	687241	569722789	28.7924	9.39402	2604.38	539758
1.20482	688900	571787000	28.8097	9.39780	2607.52	541061
1.20337	690561	573856191	28.8271	9.40157	2610.66	542365
1.20192	692224	575930368	28.8444	9.40534	2613.81	543671
1.20048	693889	578009537	28.8617	9.40911	2616.95	544979
1.19904	695556	580093704	28.8791	9.41287	2620.09	546288
1.19760	697225	582182875	28.8964	9.41663	2623.23	547599
1.19617	698896	584277056	28.9137	9.42039	2626.37	548912
1.19474	700569	586376253	28.9310	9.42414	2629.51	550226
1.19332	702244	588480472	28.9482	9.42789	2632.65	551541
1.19190	703921	590589719	28.9655	9.43164	2635.80	552858
1.19048	705600	592704000	28.9828	9.43539	2638.94	554177
1.18906	707281	594823321	29.0000	9.43913	2642.08	555497
1.18765	708964	596947688	29.0172	9.44287	2645.22	556819
1.18624	710649	599077107	29.0345	9.44661	2648.36	558142
1.18483	712336	601211584	29.0517	9.45034	2651.50	559467
1.18343	714025	603351125	29.0689	9.45407	2654.65	560794
1.18203	715716	605495736	29.0861	9.45780	2657.79	562122
1.18064	717409	607645423	29.1033	9.46152	2660.93	563452
1.17925	719104	609800192	29.1204	9.46525	2664.07	564783
1.17786	720801	611960049	29.1376	9.46897	2667.21	566116
1.17647	722500	614125000	29.1548	9.47268	2670.35	567450

NUMERICAL TABLE (Continued)

n	$1000\frac{1}{n}$	n^2	n^3	$\sqrt{n}$	$\sqrt[3]{n}$	Circum. of circle πn	Area circl $\frac{1}{4}\pi n^2$
851	1.17509	724201	616295051	29.1719	9.47640	2673.50	568786
852	1.17371	725904	618470208	29.1890	9.48011	2676.64	570124
853	1.17233	727609	620650477	29.2062	9.48381	2679.78	571463
854	1.17096	729316	622835864	29.2233	9.48752	2682.92	572803
855	1.16959	731025	625026375	29.2404	9.49122	2686.06	574146
856	1.16822	732736	627222016	29.2575	9.49492	2689.20	575490
857	1.16686	734449	629422793	29.2746	9.49861	2692.34	576835
858	1.16550	736164	631628712	29.2916	9.50231	2695.49	578182
859	1.16414	737881	633839779	29.3087	9.50600	2698.63	579530
860	1.16279	739600	636056000	29.3258	9.50969	2701.77	580880
861	1.16144	741321	638277381	29.3428	9.51337	2704.91	582232
862	1.16009	743044	640503928	29.3598	9.51705	2708.05	583585
863	1.15875	744769	642735647	29.3769	9.52073	2711.19	584940
864	1.15741	746496	644972544	29.3939	9.52441	2714.34	586297
865	1.15607	748225	647214625	29.4109	9.52808	2717.48	587655
866	1.15473	749956	649461896	29.4279	9.53175	2720.62	589014
867	1.15340	751689	651714363	29.4449	9.53542	2723.76	590375
868	1.15207	753424	653972032	29.4618	9.53908	2726.90	591738
869	1.15075	755161	656234909	29.4788	9.54274	2730.04	593102
870	1.14943	756900	658503000	29.4958	9.54640	2733.19	594468
871	1.14811	758641	660776311	29.5127	9.55006	2736.33	595835
872	1.14679	760384	663054848	29.5296	9.55371	2739.47	597204
873	1.14548	762129	665338617	29.5466	9.55736	2742.61	598575
874	1.14416	763876	667627624	29.5635	9.56101	2745.75	599947
875	1.14286	765625	669921875	29.5804	9.56466	2748.89	601320
876	1.14155	767376	672221376	29.5973	9.56830	2752.04	602696
877	1.14025	769129	674526133	29.6142	9.57194	2755.18	604073
878	1.13895	770884	676836152	29.6311	9.57557	2758.32	605451
879	1.13766	772641	679151439	29.6479	9.57921	2761.46	606831
880	1.13636	774400	681472000	29.6648	9.58284	2764.60	608212
881	1.13507	776161	683797841	29.6816	9.58647	2767.74	609595
882	1.13379	777924	686128968	29.6985	9.59009	2770.88	610980
883	1.13250	779689	688465387	29.7153	9.59372	2774.03	612366
884	1.13122	781456	690807104	29.7321	9.59734	2777.17	613754
885	1.12994	783225	693154125	29.7489	9.60095	2780.31	615143
886	1.12867	784996	695506456	29.7658	9.60457	2783.45	616534
887	1.12740	786769	697864103	29.7825	9.60818	2786.59	617927
888	1.12613	788544	700227072	29.7993	9.61179	2789.73	619321
889	1.12486	790321	702595369	29.8161	9.61540	2792.88	620717
890	1.12360	792100	704969000	29.8329	9.61900	2796.02	622114
891	1.12233	793881	707347971	29.8496	9.62260	2799.16	623513
892	1.12108	795664	709732288	29.8664	9.62620	2802.30	624913
893	1.11982	797449	712121957	29.8831	9.62980	2805.44	626315
894	1.11857	799236	714516984	29.8998	9.63339	2808.58	627718
895	1.11732	801025	716917375	29.9166	9.63698	2811.73	629124
896	1.11607	802816	719323136	29.9333	9.64057	2814.87	630530
897	1.11483	804609	721734273	29.9500	9.64415	2818.01	631938
898	1.11359	806404	724150792	29.9666	9.64774	2821.15	633348
899	1.11235	808201	726572699	29.9833	9.65132	2824.29	634760
900	1.11111	810000	729000000	30.0000	9.65489	2827.43	636173

NUMERICAL TABLE (Continued)

n	$1000\frac{1}{n}$	n^2	n^3	$\sqrt{n}$	$\sqrt[3]{n}$	Circum. of circle πn	Area of circle $\frac{1}{4}\pi n^2$
01	1.10988	811801	731432701	30.0167	9.65847	2830.58	637587
02	1.10865	813604	733870808	30.0333	9.66204	2833.72	639003
03	1.10742	815409	736314327	30.0500	9.66561	2836.86	640421
04	1.10619	817216	738763264	30.0666	9.66918	2840.00	641840
05	1.10497	819025	741217625	30.0832	9.67274	2843.14	643261
06	1.10375	820836	743677416	30.0998	9.67630	2846.28	644683
07	1.10254	822649	746142643	30.1164	9.67986	2849.42	646107
08	1.10132	824464	748613312	30.1330	9.68342	2852 57	647533
09	1.10011	826281	751089429	30.1496	9.68697	2855.71	648960
10	1.09890	828100	753571000	30.1662	9.69052	2858.85	650388
11	1.09769	829921	756058031	30.1828	9.69407	2861.99	651818
12	1.09649	831744	758550528	30.1993	9.69762	2865.13	653250
13	1.09529	833569	761048497	30.2159	9.70116	2868.27	654684
14	1.09409	835396	763551944	30.2324	9.70470	2871.42	656118
15	1.09290	837225	766060875	30.2490	9.70824	2874.56	657555
16	1.09170	839056	768575296	30.2655	9.71177	2877.70	658993
17	1.09051	840889	771095213	30.2820	9.71531	2880.84	660433
18	1.08932	842724	773620632	30.2985	9.71884	2883.98	661874
19	1.08814	844561	776151559	30.3150	9.72236	2887.12	663317
20	1.08696	846400	778688000	30.3315	9.72589	2890.27	664761
21	1.08578	848241	781229961	30.3480	9.72941	2893.41	666207
22	1.08460	850084	783777448	30.3645	9.73293	2996.55	667654
23	1.08342	851929	786330467	30.3809	9.73645	2899.69	669103
24	1.08225	853776	788889024	30.3974	9.73996	2902.83	670554
25	1.08108	855625	791453125	30.4138	9.74348	2905.97	672006
26	1.07991	857476	794022776	30.4302	9.74699	2909.11	673460
27	1.07875	859329	796597983	30.4467	9.75049	2912.26	674915
28	1.07759	861184	799178752	30.4631	9.75400	2915.40	676372
29	1.07643	863041	801765089	20.4795	9.75750	2918.54	677831
30	1.07527	864900	804357000	30.4959	9.76100	2921.68	679291
31	1.07411	866761	806954491	30.5123	9.76450	2924.82	680753
32	1.07296	868624	809557568	30.5287	9.76799	2927.96	682216
33	1.07181	870489	812166237	30.5450	9.77148	2931.11	683680
34	1.07066	872356	814780504	30.5614	9.77497	2934.25	685147
35	1.06952	874225	817400375	30.5778	9.77846	2937.39	686615
36	1.06838	876096	820025856	30.5941	9.78195	2940.53	688084
37	1.06724	877969	822656953	30.6105	9.78543	2943.67	689555
38	1.06610	879844	825293672	30.6268	9.78891	2946.81	691028
39	1.06496	881721	827936019	30.6431	9.79239	2949.96	692502
40	1.06383	883600	830584000	30.6594	9.79586	2953.10	693978
41	1.06270	885481	833237621	30.6757	9.79933	2956.24	695455
42	1.06157	887364	835896888	30.6920	9.80280	2959.38	696934
43	1.06045	889249	838561807	30.7083	9.80627	2962.52	698415
44	1.05932	891136	841232384	30.7246	9.80974	2965.66	699897
45	1.05820	893025	845908625	30.7409	9.81320	2968.81	701380
46	1.05708	894916	846590536	30.7571	9.81666	2971.95	702865
47	1.05597	896809	849278123	30.7734	9.82012	2975.09	704352
48	1.05485	898704	851971392	30.7896	9.82357	2978.23	705840
49	1.05374	900601	854670349	30.8058	9.82703	2981.37	707330
50	1.05263	902500	857375000	30.8221	9.83048	2984.51	708822

NUMERICAL TABLE (Continued)

n	$1000\frac{1}{n}$	n^2	n^3	$\sqrt{n}$	$\sqrt[3]{n}$	Circum. of circle πn	Area of circle $\frac{1}{4}\pi n^2$
951	1.05152	904401	860085351	30.8383	9.83392	2987.65	710315
952	1.05042	906304	862801408	30.8545	9.83737	2990.80	711810
953	1.04932	908209	865523177	30.8707	9.84081	2993.94	713306
954	1.04822	910116	868250664	30.8869	9.84425	2997.08	714803
955	1.04712	912025	870983875	30.9031	9.84769	3000.22	716303
956	1.04603	913936	873722816	30.9192	9.85113	3003.36	717804
957	1.04493	915849	876467493	30.9354	9.85456	3006.50	719306
958	1.04384	917764	879217912	30.9516	9.85799	3009.65	720810
959	1.04275	919681	881974079	30.9677	9.86142	3012.79	722316
960	1.04167	921600	884736000	30.9839	9.86485	3015.93	723823
961	1.04058	923521	887503681	31.0000	9.86827	3019.07	725332
962	1.03950	925444	890277128	31.0161	9.87169	3022.21	726842
963	1.03842	927369	893056347	31.0322	9.87511	3025.35	728354
964	1.03734	929296	895841344	31.0483	9.87853	3028.50	729867
965	1.03627	931225	898632125	31.0644	9.88195	3031.64	731382
966	1.03520	933156	901428696	31.0805	9.88536	3034.78	732899
967	1.03413	935089	904231063	31.0966	9.88877	3037.92	734417
968	1.03306	937024	907039232	31.1127	9.89217	3041.06	735937
969	1.03199	938961	909853209	31.1288	9.89558	3044.20	737458
970	1.03093	940900	912673000	31.1448	9.89898	3047.34	738981
971	1.02987	942841	915498611	31.1609	9.90238	3050.49	740506
972	1.02881	944784	918330048	31.1769	9.90578	3053.63	742032
973	1.02775	946729	921167317	31.1929	9.90918	3056.77	743559
974	1.02669	948676	924010424	31.2090	9.91257	3059.91	745088
975	1.02564	950625	926859375	31.2250	9.91596	3063.05	746619
976	1.02459	952576	929714176	31.2410	9.91935	3066.19	748151
977	1.02354	954529	932574833	31.2570	9.92274	3069.34	749685
978	1.02249	956484	935441352	31.2730	9.92612	3072.48	751221
979	1.02145	958441	938313739	31.2890	9.92950	3075.62	752758
980	1.02041	960400	941192000	31.3050	9.93288	3078.76	754296
981	1.01937	962361	944076141	31.3209	9.93626	3081.90	755837
982	1.01833	964324	946966168	31.3369	9.93964	3085.04	757378
983	1.01729	966289	949862087	31.3528	9.94301	3088.19	758922
984	1.01626	968256	952763904	31.3688	9.94638	3091.33	760466
985	1.01523	970225	955671625	31.3847	9.94975	3094.47	762013
986	1.01420	972196	958585256	31.4006	9.95311	3097.61	763561
987	1.01317	974169	961504803	31.4166	9.95648	3100.75	765111
988	1.01215	976144	964430272	31.4325	9.95984	3103.89	766662
989	1.01112	978121	967361669	31.4484	9.96320	3107.04	768214
990	1.01010	980100	970299000	31.4643	9.96655	3110.18	769769
991	1.00908	982081	973242271	31.4802	9.96991	3113.32	771325
992	1.00806	984064	976191488	31.4960	9.97326	3116.46	772882
993	1.00705	986049	979146657	31.5119	9.97661	3119.60	774441
994	1.00604	988036	982107784	31.5278	9.97996	3122.74	776002
995	1.00503	990025	985074875	31.5436	9.98331	3125.88	777564
996	1.00402	992016	988047936	31.5595	9.98665	3129.03	779128
997	1.00301	994009	991026973	31.5753	9.98999	3132.17	780693
998	1.00200	996004	994011992	31.5911	9.99333	3135.31	782260
999	1.00100	998001	997002999	31.6070	9.99667	3138.45	783828

INTEREST TABLES

If P is the principal placed at interest at a rate r (expressed as a decimal), for a period of n years, the **amount** A is given as follows:

At simple interest, $A = P(1 + nr)$

At interest compounded annually, $A = P(1 + r)^n$

At interest compounded q times per year, $A = P\left(1 + \frac{r}{q}\right)^{nq}$

Present value, P of an amount A due in n years at a rate r:

At simple interest $P = \frac{A}{1 + nr}$

At interest compounded annually $P = \frac{A}{(1 + r)^n}$

At interest compounded q times per year $P = \frac{A}{\left(1 + \frac{r}{q}\right)^{nq}}$

Annuity N that a principal P, drawing interest at the rate r will give for a period of n years, interest compounded annually:

$$N = P\frac{r(1 + r)^n}{(1 + r)^n - 1}$$

Present Value of the Annuity, conditions as above:

$$P = N\frac{(1 + r)^n - 1}{r(1 + r)^n}$$

Amount of Sinking Fund S, created by a fixed (end of year) investment N placed annually at compound interest r for n years

$$S = N\frac{(1 + r)^n - 1}{r}$$

Fixed investment, N placed annually at compound interest for a term of n years to create a sinking fund S

$$N = S\frac{r}{(1 + r)^n - 1}$$

The table gives the values of $(1 + r)^n$ for values of r from 0.0025 to 0.08 and n from 1 to 50.

INTEREST TABLES

Years	Rate r				
n	.0025 (¼ %)	.005 (½ %)	.0075 (¾ %)	.01 (1 %)	.0125 (1¼ %
1	1.0025000	1.0050000	1.0075000	1.0100000	1.0125000
2	1.0050063	1.0100250	1.0150563	1.0201000	1.0251563
3	1.0075188	1.0150751	1.0226692	1.0303010	1.0379707
4	1.0100376	1.0201505	1.0303392	1.0406040	1.0509453
5	1.0125627	1.0252518	1.0380667	1.0510101	1.0640822
6	1.0150941	1.0303775	1.0458522	1.0615202	1.0773832
7	1.0176318	1.0355294	1.0536961	1.0721353	1.0908505
8	1.0201759	1.0407070	1.0615988	1.0828567	1.1044861
9	1.0227263	1.0459106	1.0695608	1.0936843	1.1182922
10	1.0252831	1.0511401	1.0775825	1.1046211	1.1322708
11	1.0278463	1.0563958	1.0856644	1.1156673	1.1464242
12	1.0304160	1.0616778	1.0938069	1.1268240	1.1607545
13	1.0329920	1.0669862	1.1020104	1.1380922	1.1752639
14	1.0355745	1.0723211	1.1102755	1.1494732	1.1899547
15	1.0381634	1.0776827	1.1186026	1.1609679	1.2048292
16	1.0407588	1.0830712	1.1269921	1.1725776	1.2198895
17	1.0433607	1.0884865	1.1354446	1.1843033	1.2351382
18	1.0459691	1.0939289	1.1439604	1.1961464	1.2505774
19	1.0485840	1.0993986	1.1525401	1.2081078	1.2662096
20	1.0512055	1.1048956	1.1611841	1.2201889	1.2820372
21	1.0538335	1.1104201	1.1698930	1.2323908	1.2980627
22	1.0564681	1.1159722	1.1786672	1.2447147	1.3142885
23	1.0591093	1.1215520	1.1875072	1.2571619	1.3307171
24	1.0617570	1.1271598	1.1964135	1.2697335	1.3473510
25	1.0644114	1.1327956	1.2053866	1.2824308	1.3641929
26	1.0670725	1.1384596	1.2144270	1.2952551	1.3812453
27	1.0697401	1.1441519	1.2235352	1.3082077	1.3985109
28	1.0724145	1.1498726	1.2327117	1.3212898	1.4159923
29	1.0750955	1.1556220	1.2419570	1.3345027	1.4336922
30	1.0777833	1.1614001	1.2512718	1.3478477	1.4516134
31	1.0804777	1.1672071	1.2606563	1.3613262	1.4697585
32	1.0831789	1.1730431	1.2701112	1.3749394	1.4881305
33	1.0858869	1.1789083	1.2796371	1.3886888	1.5067321
34	1.0886016	1.1848029	1.2892343	1.4025757	1.5255663
35	1.0913231	1.1907269	1.2989036	1.4166015	1.5446359
36	1.0940514	1.1966805	1.3086454	1.4307675	1.5639438
37	1.0967865	1.2029664	1.3184602	1.4450752	1.5834931
38	1.0995285	1.2089812	1.3283487	1.4595259	1.6032868
39	1.1022773	1.2150261	1.3383113	1.4741212	1.6233279
40	1.1050330	1.2211013	1.3483486	1.4888624	1.6436195
41	1.1077956	1.2272068	1.3584612	1.5037510	1.6641647
42	1.1105651	1.2333428	1.3686497	1.5187885	1.6849668
43	1.1133415	1.2395095	1.3789146	1.5339764	1.7060288
44	1.1161248	1.2457071	1.3892564	1.5493162	1.7273542
45	1.1189152	1.2519356	1.3996758	1.5648093	1.7489461
46	1.1217124	1.2581953	1.4101734	1.5804574	1.7708080
47	1.1245167	1.2644863	1.4207497	1.5962620	1.7929431
48	1.1273280	1.2708087	1.4314053	1.6122246	1.8153549
49	1.1301463	1.2771627	1.4421409	1.6283469	1.8380468
50	1.1329717	1.2835485	1.4529570	1.6446303	1.8610224

INTEREST TABLES (Continued)

Years	Rate r				
n	.015 (1½ %)	.0175 (1¾ %)	.02 (2 %)	.0225 (2¼ %)	.025 (2½ %)
1	1.0150000	1.0175000	1.0200000	1.0225000	.02500 00
2	1.0302250	1.0353063	1.0404000	1.0455063	1.0506250
3	1.0456784	1.0534241	1.0612080	1.0690301	1.0768906
4	1.0613636	1.0718590	1.0824322	1.0930833	1.1038129
5	1.0772840	1.0906166	1.1040808	1.1176777	1.1314082
6	1.0934433	1.1097024	1.1261624	1.1428254	1.1596934
7	1.1098449	1.1291221	1.1486857	1.1685390	1.1886858
8	1.1264926	1.1488818	1.1716594	1.1948311	1.2184029
9	1.1433900	1.1689872	1.1950926	1.2217148	1.2488630
10	1.1605408	1.1894445	1.2189944	1.2492034	1.2800845
11	1.1779489	1.2102598	1.2433743	1.2773105	1.3120867
12	1.1956182	1.2314393	1.2682418	1.3060500	1.3448888
13	1.2135524	1.2529895	1.2936066	1.3354361	1.3785110
14	1.2317557	1.2749168	1.3194788	1.3654834	1.4129738
15	1.2502321	1.2972279	1.3458683	1.3962068	1.4482982
16	1.2689855	1.3199294	1.3727857	1.4276215	1.4845056
17	1.2880203	1.3430281	1.4002414	1.4597429	1.5216183
18	1.3073406	1.3665311	1.4282462	1.4925872	1.5596587
19	1.3269507	1.3904454	1.4568112	1.5261704	1.5986502
20	1.3468550	1.4147782	1.4859474	1.5605092	1.6386164
21	1.3670578	1.4395368	1.5156663	1.5956207	1.6795819
22	1.3875637	1.4647287	1.5459797	1.6315221	1.7215714
23	1.4083772	1.4903615	1.5768993	1.6682314	1.7646107
24	1.4295028	1.5164428	1.6084372	1.7057666	1.8087259
25	1.4509454	1.5429805	1.6406060	1.7441463	1.8539441
26	1.4727095	1.5699827	1.6734181	1.7833896	1.9002927
27	1.4948002	1.5974574	1.7068865	1.8235159	1.9478000
28	1.5172222	1.6254129	1.7410242	1.8645450	1.9964950
29	1.5399805	1.6538576	1.7758447	1.9064973	2.0464074
30	1.5630802	1.6822800	1.8113616	1.9493934	2.0975658
31	1.5865264	1.7122491	1.8475888	1.9932548	2.1500068
32	1.6103243	1.7422135	1.8845406	2.0381030	2.2037569
33	1.6344792	1.7727022	1.9222314	2.0839603	2.2588509
34	1.6589964	1.8037245	1.9606760	2.1308494	2.3153221
35	1.6838813	1.8352897	1.9998896	2.1787936	2.3732052
36	1.7091395	1.8674073	2.0398873	2.2278164	2.4325353
37	1.7347766	1.9000869	2.0806851	2.2779423	2.4933487
38	1.7607983	1.9333384	2.1222988	2.3291960	2.5556824
39	1.7872103	1.9671718	2.1647448	2.3816029	2.6195745
40	1.8140184	2.0015973	2.2080397	2.4351890	2.6850638
41	1.8412287	2.0366253	2.2522005	2.4899807	2.7521904
42	1.8688471	2.0722662	2.2972445	2.5460053	2.8209952
43	1.8968798	2.1085309	2.3431894	2.6032904	2.8915201
44	1.9253330	2.1454302	2.3900531	2.6618644	2.9638081
45	1.9542130	2.1829752	2.4378542	2.7217564	3.0379033
46	1.9835262	2.2211773	2.4866113	2.7829959	3.1138509
47	2.0132791	2.2600479	2.5363435	2.8456133	3.1916971
48	2.0434783	2.2995987	2.5870704	2.9096396	3.2714896
49	2.0741305	2.3398417	2.6388118	2.9751065	3.3532768
50	2.1052424	2.3807889	2.6915880	3.0420464	3.4371087

INTEREST TABLES (Continued)

Years	Rate r				
n	.0275 (2¾ %)	.03 (3 %)	.0325 (3¼ %)	.035 (3½ %)	.0375 (3¾ %)
1	1.0275000	1.0300000	1.0325000	1.0350000	1.0375000
2	1.0557563	1.0609000	1.0660563	1.0712250	1.0764063
3	1.0847895	1.0927270	1.1007031	1.1087179	1.1167715
4	1.1146203	1.1255088	1.1364759	1.1475230	1.1586504
5	1.1452723	1.1592741	1.1734114	1.1876863	1.2020998
6	1.1767673	1.1940523	1.2115473	1.2292553	1.2471785
7	1.2091284	1.2298739	1.2509226	1.2722793	1.2933948
8	1.2423794	1.2667701	1.2915775	1.3168090	1.3422471
9	1.2765449	1.3047732	1.3335538	1.3628974	1.3928134
10	1.3116499	1.3439164	1.3768943	1.4105988	1.4450439
11	1.3477202	1.3842339	1.4216434	1.4599697	1.4992331
12	1.3847825	1.4257609	1.4678468	1.5110687	1.5554543
13	1.4228641	1.4685337	1.5155518	1.5639561	1.6137839
14	1.4619928	1.5125898	1.5648072	1.6186945	1.6743008
15	1.5021976	1.5579674	1.6156635	1.6753488	1.7370870
16	1.5435081	1.6047064	1.6681725	1.7339860	1.8022278
17	1.5859545	1.6528476	1.7223881	1.7946756	1.8698113
18	1.6295683	1.7024331	1.7783658	1.8574892	1.9399293
19	1.6743814	1.7535061	1.8361626	1.9225013	2.0126766
20	1.7204269	1.8061112	1.8958379	1.9897889	2.0881520
21	1.7677386	1.8602946	1.9574527	2.0594315	2.1664577
22	1.8163514	1.9161034	2.0210699	2.1315116	2.2477000
23	1.8663011	1.9735865	2.0867546	2.2061145	2.3319886
24	1.9176244	2.0327941	2.1545742	2.2833285	2.4194382
25	1.9703591	2.0937779	2.2245978	2.3632450	2.5101671
26	2.0245439	2.1565913	2.2968973	2.4459586	2.6042984
27	2.0802189	2.2212890	2.3715464	2.5315671	2.7019596
28	2.1374249	2.2879277	2.4486217	2.6201720	2.8032830
29	2.1962041	2.3565506	2.5282019	2.7118780	2.9084062
30	2.2565997	2.4272625	2.6103684	2.8067937	3.0174714
31	2.3186562	2.5000803	2.6952054	2.9050315	3.1306266
32	2.3824192	2.5750828	2.7827996	3.0067076	3.2480251
33	2.4479358	2.6523352	2.8732401	3.1119423	3.3698260
34	2.5152540	2.7319053	2.9666209	3.2208603	3.4961945
35	2.5844235	2.8138625	3.0630361	3.3335904	3.6273018
36	2.6554951	2.8982783	3.1625847	3.4502661	3.7633256
37	2.7285212	2.9852267	3.2653687	3.5710254	3.9044503
38	2.8035556	3.0747835	3.3714932	3.6960113	4.0508672
39	2.8806534	3.1670270	3.4810668	3.8253717	4.2027747
40	2.9598713	3.2620378	3.5942014	3.9592597	4.3603788
41	3.0412678	3.3598989	3.7110130	4.0978338	4.5238930
42	3.1249027	3.4606959	3.8316209	4.2412580	4.6935389
43	3.2108375	3.5645168	3.9561486	4.3897020	4.8695467
44	3.2991355	3.6714523	4.0847234	4.5433416	5.0521547
45	3.3898617	3.7815958	4.2174769	4.7023585	5.2416103
46	3.4830829	3.8950437	4.3545449	4.8669411	5.4381708
47	3.5788677	4.0118950	4.4960676	5.0372840	5.6421023
48	3.6772866	4.1322519	4.6421898	5.2135890	5.8536813
49	3.7784120	4.2562194	4.7930610	5.3960646	6.0731947
50	3.8823183	4.3839060	4.9488355	5.5849269	6.3009388

INTEREST TABLES (Continued)

Years	Rate r				
n	.04 (4 %)	.0425 (4¼ %)	.045 (4½ %)	.0475 (4¾ %)	.05 (5 %)
1	1.0400000	1.0425000	1.0450000	1.0475000	1.0500000
2	1.0816000	1.0868063	1.0920250	1.0972563	1.1025000
3	1.1248640	1.1329955	1.1411661	1.1493759	1.1576250
4	1.1698586	1.1811478	1.1925186	1.2039713	1.2155063
5	1.2166529	1.2313466	1.2461819	1.2611599	1.2762816
6	1.2653190	1.2836788	1.3022601	1.3210650	1.3400956
7	1.3159318	1.3382352	1.3608618	1.3838156	1.4071004
8	1.3685691	1.3951102	1.4221006	1.4495468	1.4774554
9	1.4233118	1.4544024	1.4860951	1.5184003	1.5513282
10	1.4802443	1.5162145	1.5529694	1.5905243	1.6288946
11	1.5394541	1.5806536	1.6228530	1.6660742	1.7103394
12	1.6010322	1.6478314	1.6958814	1.7452128	1.7958562
13	1.6650735	1.7178642	1.7721961	1.8281104	1.8856491
14	1.7316764	1.7908734	1.8519449	1.9149456	1.9799316
15	1.8009435	1.8669856	1.9352824	2.0059055	1.0789282
16	1.8729812	1.9463324	2.0223702	2.1011860	2.1828746
17	1.9479005	2.0290516	2.1133768	2.2009924	2.2920183
18	2.0258165	2.1152863	2.2084788	2.3055395	2.4066192
19	2.1068492	2.2051860	2.3078603	2.4150526	2.5269502
20	2.1911231	2.2989064	2.4117140	2.5297676	2.6532977
21	2.2787681	2.3966099	2.5202412	2.6499316	2.7859626
22	2.3699188	2.4984658	2.6336520	2.7758034	2.9252607
23	2.4647155	2.6046506	2.7521663	2.9076540	3.0715238
24	2.5633042	2.7153482	2.8760138	3.0457676	3.2250999
25	2.6658363	2.8307505	3.0054345	3.1904415	3.3863549
26	2.7724698	2.9510574	3.1406790	3.3419875	3.5556727
27	2.8833686	3.0764774	3.2820096	3.5007319	3.7334563
28	2.9987033	3.2072277	3.4297000	3.6670167	3.9201294
29	3.1186515	3.3435349	3.5840365	3.8412000	4.1161356
30	3.2433975	3.4856351	3.7453181	4.0236570	4.3219424
31	3.3731334	3.6337746	3.9138574	4.2147807	4.5380395
32	3.5080587	3.7882100	4.0899810	4.4149828	4.7649415
33	3.6483811	3.9492089	4.2740302	4.6246944	5.0031885
34	3.7943163	4.1170503	4.4663615	4.8443674	5.2533480
35	3.9460890	4.2920249	4.6673478	5.0744749	5.5160154
36	4.1039326	4.4744360	4.8773785	5.3155124	5.7918161
37	4.2680899	4.6645995	5.0968605	5.5679993	6.0814069
38	4.4388134	4.8628450	5.3262192	5.8324792	6.3854773
39	4.6163660	5.0695159	5.5658991	6.1095220	6.7047512
40	4.8010206	5.2849703	5.8163645	6.3997243	7.0399887
41	4.9930615	5.5095816	6.0781009	6.7037112	7.3919887
42	5.1927839	5.7437388	6.3516155	7.0221375	7.7615876
43	5.4004953	5.9878477	6.6374382	7.3556890	8.1496669
44	5.6165151	6.2423312	6.9361229	7.7050842	8.5571503
45	5.8411757	6.5076304	7.2482484	8.0710757	8.9850078
46	6.0748227	6.7842047	7.5744196	8.4544518	9.4342582
47	6.3178156	7.0725334	7.9152685	8.8560383	9.9059711
48	6.5705282	7.3731160	8.2714556	9.2767001	10.4012696
49	6.8333494	7.6864735	8.6436711	9.7173434	10.9213331
50	7.1066833	8.0131486	9.0326363	10.1789172	11.4673998

INTEREST TABLES (Continued)

Years	Rate r				
n	.0525 (5¼ %)	.055 (5½ %)	.0575 (5¾ %)	.06 (6 %)	.0625 (6¼ %)
1	1.0525000	1.0550000	1.0575000	1.0600000	1.0625000
2	1.1077563	1.1130250	1.1183063	1.1236000	1.1289062
3	1.1659135	1.1742414	1.1826089	1.1910160	1.1994629
4	1.2271239	1.2388247	1.2506089	1.2624770	1.2744293
5	1.2915479	1.3069600	1.3225189	1.3382256	1.3540812
6	1.3593542	1.3788428	1.3985637	1.4185191	1.4387112
7	1.4307203	1.4546792	1.4789811	1.5036303	1.5286307
8	1.5058331	1.5346865	1.5640225	1.5938481	1.6241701
9	1.5848893	1.6190943	1.6539538	1.6894790	1.7256807
10	1.6680960	1.7081445	1.7490562	1.7908477	1.8335358
11	1.7556711	1.8020924	1.8496269	1.8982986	1.9481318
12	1.8478438	1.9012075	1.9559805	2.0121965	2.0698900
13	1.9448556	2.0057739	2.0684493	2.1329283	2.1992581
14	2.0469605	2.1160915	2.1873852	2.2609040	2.3367117
15	2.1544259	2.2324765	2.3131598	2.3965582	2.4827562
16	2.2675333	2.3552627	2.4461665	2.5403517	2.6379285
17	2.3865788	2.4848021	2.5868211	2.6927728	2.8027990
18	2.5118742	2.6214663	2.7355633	2.8543392	2.9779740
19	2.6437476	2.7656469	2.8928582	3.0255995	3.1640973
20	2.7825443	2.9177575	3.0591975	3.2071355	3.3168534
21	2.9286279	3.0782342	3.2351014	3.3995636	3.5719693
22	3.0823809	3.2475370	3.4211197	3.6035374	3.7952173
23	3.2442059	3.4261516	3.6178341	3.8197497	4.0324184
24	3.4145267	3.6145900	3.8258596	4.0489346	4.2844446
25	3.5937893	3.8133923	4.0458465	4.2918707	4.5522224
26	3.7824632	4.0231289	4.2784827	4.5493830	4.8367363
27	3.9810426	4.2444010	4.5244954	4.8223460	5.1390323
28	4.1900473	4.4778431	4.7846539	5.1116867	5.4602218
29	4.41002a7	4.7241244	5.0597715	5.4183879	5.8014857
30	4.6415511	4.9839513	5.3507084	5.7434912	6.1640785
31	4.8852325	5.2580686	5.6583741	6.0881006	6.5493334
32	5.1417072	5.5472624	5.9837306	6.4533867	6.9586668
33	5.4116469	5.8523618	6.3277951	6.8405899	7.3935834
34	5.6957583	6.1742417	6.6916433	7.2510253	7.8556824
35	5.9947856	6.5138250	7.0764128	7.6860868	8.3466625
36	6.3095119	6.8720854	7.4833066	8.1472520	8.8683289
37	6.6407612	7.2500501	7.9135967	8.6360871	9.4226000
38	6.9894012	7.6488028	8.3686285	9.1542523	10.0115120
39	7.3563448	8.0694870	8.8498246	9.7035075	10.6372315
40	7.7425529	8.5133088	9.3586896	10.2857179	11.3020584
41	8.1490369	8.9815408	9.8968142	10.9028610	12.0084371
42	8.5768613	9.4755255	10.4658810	11.5570327	12.7589644
43	9.0271466	9.9966794	11.0676692	12.2504546	13.5563997
44	9.5010718	10.5464968	11.7040602	12.9854819	14.4036747
45	9.9998780	11.1265541	12.3770436	13.7646108	15.3039043
46	10.5248716	11.7385146	13.0887236	14.5904875	16.2603983
47	11.0774274	12.3841329	13.8413252	15.4659167	17.2766732
48	11.6589923	13.0652602	14.6372014	16.3938717	18.3564653
49	12.2710894	13.7838495	15.4788405	17.3775040	19.5037444
50	12.9153216	14.5419612	16.3688738	18.2015426	20.7227284

INTEREST TABLES (Continued)

Years	Rate r				
n	.065 (6½ %)	.0675 (6¾ %)	.07 (7 %)	.0725 (7¼ %)	.075 (7½ %)
1	1.0650000	1.0675000	1.0700000	1.0725000	1.0750000
2	1.1342250	1.1395563	1.1449000	1.1502563	1.1556250
3	1.2079496	1.2164763	1.2250430	1.2336498	1.2422969
4	1.2864664	1.2985884	1.3107960	1.3230894	1.3354691
5	1.3700867	1.3862432	1.4025517	1.4190134	1.4356293
6	1.4591423	1.4798146	1.5007304	1.5218919	1.5433015
7	1.5539865	1.5797020	1.6057815	1.6322291	1.6590491
8	1.6549957	1.6863319	1.7181862	1.7505657	1.7834778
9	1.7625704	1.8001593	1.8384592	1.8774817	1.9172387
10	1.8771375	1.9216701	1.9671514	2.0135991	2.0610316
11	1.9991514	2.0513828	2.1048520	2.1595850	2.2156089
12	2.1290962	2.1898512	2.2521916	2.3161549	2.3817796
13	2.2674875	2.3376661	2.4098450	2.4840762	2.5604131
14	2.4148742	2.4954586	2.5785341	2.6641717	2.7524440
15	2.5718410	2.6639020	2.7590315	2.8573242	2.9588774
16	2.7390107	2.8437154	2.9521637	3.0644802	3.1807932
17	2.9170464	3.0356662	3.1588152	3.2866550	3.4193526
18	3.1066544	3.2405737	3.3799323	3.5249375	3.6758041
19	3.3085869	3.4593124	3.6165275	3.7804954	3.9514894
20	3.5236451	3.6928160	3.8696845	4.0545813	4.2478511
21	3.7526820	3.9420811	4.1405624	4.3485385	4.5664399
22	3.9966063	4.2081715	4.4304017	4.6638075	4.9089229
23	4.2563857	4.4922231	4.7405299	5.0019336	5.2770921
24	4.5330508	4.7954482	5.0723670	5.3645738	5.6728741
25	4.8276991	5.1191409	5.4274326	5.7535053	6.0983396
26	5.1414995	5.4646830	5.8073529	6.1706345	6.5557151
27	5.4756970	5.8335491	6.2138676	6.6180055	7.0473937
28	5.8316173	6.2273136	6.6488384	7.0978109	7.5759482
29	6.2106725	6.6476573	7.1142570	7.6124022	8.1441444
30	6.6143662	7.0963741	7.6122550	8.1643013	8.7549552
31	7.0443000	7.5753794	8.1451129	8.7562132	9.4115768
32	7.5021795	8.0867175	8.7152708	9.3910386	10.1174451
33	7.9898211	8.6325709	9.3253398	10.0718889	10.8762535
34	8.5091595	9.2152695	9.9781135	10.8021009	11.6919725
35	9.0622549	9.8373002	10.6765815	11.5852532	12.5688704
36	9.6513014	10.5013179	11.4239422	12.4251840	13.5115357
37	10.2786360	11.2101569	12.2236181	13.3260099	14.5249009
38	10.9467474	11.9668425	13.0792714	14.2921456	15.6142684
39	11.6582859	12.7746044	13.9948204	15.3283262	16.7853386
40	12.4160745	13.6368901	14.9744578	16.4396298	18.0442390
41	13.2231194	14.5573802	16.0226699	17.6315030	19.3975569
42	14.0826221	15.5400034	17.1442568	18.9097869	20.8523737
43	14.9979926	16.5889536	18.3443547	20.2807465	22.4163017
44	15.9728621	17.7087080	19.6284596	21.7511006	24.0975243
45	17.0110981	18.9040458	21.0024517	23.3280554	25.9048386
46	18.1168195	20.1800689	22.4726234	25.0193941	27.8477015
47	19.2944128	21.5422235	24.0457070	26.8332415	29.9362791
48	20.5485496	22.9963236	25.7289065	28.7786515	32.1815000
49	21.8842053	24.5485754	27.5299300	30.8651038	34.5951125
50	23.3066787	26.2056043	29.4570250	33.1028238	37.1897460

INTEREST TABLES (Continued)

Years	Rate r	
n	.0075 (7¾ %)	.08 (8 %)
1	1.0775000	1.0800000
2	1.1610063	1.1664000
3	1.2509842	1.2597120
4	1.3479355	1.3604890
5	1.4524005	1.4693281
6	1.5649616	1.5868743
7	1.6862461	1.7138243
8	1.8169301	1.8509302
9	1.9577422	1.9990046
10	2.1094673	2.1589250
11	2.2729510	2.3316390
12	2.4491047	2.5181701
13	2.6389103	2.7196237
14	2.8434258	2.9371936
15	3.0637913	3.1721691
16	3.3012352	3.4259426
17	3.5570809	3.7000181
18	3.8327546	3.9960195
19	4.1297931	4.3157011
20	4.4498521	4.6609571
21	4.7947156	5.0338337
22	5.1663061	5.4365404
23	5.5666948	5.8714636
24	5.9981137	6.3411807
25	6.4629675	6.8484752
26	6.9638465	7.3963532
27	7.5035446	7.9880615
28	8.0850693	8.6271064
29	8.7116621	9.3172749
30	9.3868159	10.0626569
31	10.1142942	10.8676694
32	10.8981520	11.7370830
33	11.7427588	12.6760496
34	12.6528226	13.6901336
35	13.6334163	14.7853443
36	14.6900061	15.9681718
37	15.8284815	17.2456256
38	17.0551889	18.6252756
39	18.3769660	20.1152977
40	19.8011808	21.7245215
41	21.3357724	23.4624832
42	22.0892947	25.3394819
43	24.7709651	27.3666404
44	26.6907149	29.5559716
45	28.7592453	31.9204494
46	30.9880868	34.4740853
47	33.3896635	37.2320121
48	35.9773624	40.2105731
49	38.7656080	43.4274190
50	41.7699426	46.9016247

GENERAL CHEMICAL TABLES

* INTERNATIONAL ATOMIC WEIGHTS

1925

Name	Symbol	At. No.	At. Wt.	Valence
Aluminum	Al	13	26.97	3
Antimony, stibium	Sb	51	121.77	3, 5
Argon	A	18	39.91	0
Arsenic	As	33	74.96	3, 5
Barium	Ba	56	137.37	2
Beryllium, glucinum	Be	4	9.02	2
Bismuth	Bi	83	209.00	3, 5
Boron	B	5	10.82	3
Bromine	Br	35	79.916	1
Cadmium	Cd	48	112.41	2
Calcium	Ca	20	40.07	2
Cæsium	Cs	55	132.81	1
Carbon	C	6	12.000	2, 4
Cerium	Ce	58	140.25	4, 3
Chlorine	Cl	17	35.457	1
Chromium	Cr	24	52.01	2, 3, 6
Cobalt	Co	27	58.94	2, 3
Columbium, niobium	Cb	41	93.1	3, 5
Copper	Cu	29	63.57	1, 2
Dysprosium	Dy	66	162.52	3
Erbium	Er	68	167.7	3
Europium	Eu	63	152.0	3
Fluorine	F	9	19.00	1
Gadolinium	Gd	64	157.26	3
Gallium	Ga	31	69.72	3
Germanium	Ge	32	72.60	4
Gold, aurum	Au	79	197.2	1, 3
Hafnium, celtium †	Hf	72	180.8	
Helium	He	2	4.00	0
Holmium	Ho	67	163.4	3
Hydrogen	H	1	1.008	1
Indium	In	49	114.8	3
Iodine	I	53	126.932	1
Iridium	Ir	77	193.1	3, 4
Iron, ferrum	Fe	26	55.84	2, 3
Krypton	Kr	36	82.9	0
Lanthanum	La	57	138.90	3
Lead, plumbum	Pb	82	207.20	2, 4
Lithium	Li	3	6.940	1
Lutecium	Lu	71	175.0	3
Magnesium	Mg	12	24.32	2
Manganese	Mn	25	54.93	2, 4, 6, 7
Mercury, hydrargyrum	Hg	80	200.61	1, 2
Molybdenum	Mo	42	96.0	3, 4, 6
Neodymium	Nd	60	144.27	3
Neon	Ne	10	20.2	0
Nickel	Ni	28	58.69	2, 3
Nitrogen	N	7	14.008	3, 5
Osmium	Os	76	190.8	2, 3 4, 8
Oxygen	O	8	16.000	2
Palladium	Pd	46	106.7	2, 4
Phosphorus	P	15	31.027	3, 5
Platinum	Pt	78	195.23	2, 4
Potassium, kalium	K	19	39.096	1
Praseodymium	Pr	59	140.92	3
Radium	Ra	88	225.95	2
Radon, niton	Rn	86	222.	
Rhodium	Rh	45	102.91	3
Rubidium	Rb	37	85.44	1
Ruthenium	Ru	44	101.7	3, 4, 6, 8
Samarium	Sa	62	150.43	3
Scandium	Sc	21	45.10	3
Selenium	Se	34	79.2	2, 4, 6
Silicon	Si	14	28.06	4
Silver, argentum	Ag	47	107.880	1
Sodium, natrium	Na	11	22.997	1
Strontium	Sr	38	87.63	2
Sulfur	S	16	32.064	2, 4, 6
Tantalum	Ta	73	181.5	5
Tellurium	Te	52	127.5	2, 4, 6
Terbium	Tb	65	159.2	3
Thallium	Tl	81	204.39	1, 3
Thorium	Th	90	232.15	4
Thulium	Tm	69	169.4	3
Tin, stannum	Sn	50	118.70	2, 4
Titanium	Ti	22	48.1	3, 4
Tungsten, wolframium	W	74	184.0	6
Uranium	U	92	238.17	4, 6
Vanadium	V	23	50.96	3, 5
Xenon	Xe	54	130.2	0
Ytterbium	Yb	70	173.6	3
Yttrium	Y	39	88.9	3
Zinc	Zn	30	65.38	2
Zirconium	Zr	40	91.	4

* Jour. Amer. Chem. Soc. March, 1925.

† Hafnium is not included in the International Table.

MOLECULAR WEIGHTS AND THEIR LOGARITHMS

Compound	Mol. wt.	Log.	Compound	Mol. wt.	Log.
Aluminum, Al	26.97	1.43088	$Cr_2(SO_4)_3$	392.21	2.59352
Al_2O_3	101.94	2.00834	Cobalt, Co	58.94	1.77041
$Al(OH)_3$	77.99	1.89204	$CoCl_2$	129.85	2.11344
$AlCl_3$	133.34	2.12496	CoO	74.94	1.87471
Al_2S_3	150.13	2.17647	Co_2O_3	165.88	2.21970
$Al_2(SO_4)_3$	342.13	2.53419	Co_3O_4	240.82	2.38169
$Al_2(SO_4)_3.K_2SO_4.24H_2O$	948.77	2.97716	Copper, Cu	63.57	1.80325
			CuCl	149.03	2.17327
$Al_2(SO_4)_3.Na_2SO_4.24H_2O$	916.57	2.96217	$CuCl_2$	134.48	2.12866
			CuO	79.57	1.90075
Ammonium			Cu_2O	143.14	2.15576
NH_4Cl	53.50	1.72835	CuS	95.63	1.98059
NH_4NO_3	80.05	1.90336	Cu_2S	159.20	2.20194
$(NH_4)_2SO_4$	132.14	2.12103	$CuSO_4$	159.63	2.20306
Antimony, Sb	121.77	2.08909	Fluorine, F_2	38.00	1.57979
$SbCl_3$	228.14	2.35820	HF	20.01	1.30125
$SbCl_5$	299.06	2.47576	H_2SiF_6	144.08	2.15860
Sb_2O_3	291.54	2.46470	Gold, Au	197.2	2.29491
Sb_2O_5	323.54	2.50993	AuCl	232.66	2.36672
Sb_2S_3	339.73	2.53113	$AuCl_3$	303.57	2.48226
Sb_2S_5	403.86	2.60623	Hydrogen, H_2	2.016	0.30449
Arsenic, As_4	299.84	2.47689	H_2O	18.02	1.25575
$AsCl_3$	181.33	2.25847	H_2O_2	34.02	1.53173
As_2O_3	197.92	2.29649	Iodine, I_2	253.86	2.40459
As_2O_5	229.92	2.36158	HI	127.94	2.10700
As_2S_3	246.11	2.39113	Iron, Fe	55.84	1.74695
As_2S_5	309.24	2.49030	$FeCl_2$	126.75	2.10295
Barium, Ba	137.37	2.13789	$FeCl_3$	162.21	2.21008
$BaCO_3$	197.37	2.29528	$Fe(OH)_2$	89.86	1.95357
$BaCl_2$	208.28	2.31865	$Fe(OH)_3$	106.86	2.02882
$BaCrO_4$	253.38	2.40377	FeO	71.84	1.85637
BaO	153.37	2.18574	Fe_2O_3	159.68	2.20325
$BaSO_4$	233.43	2.36816	FeS	87.90	1.94399
$BaSiF_6$	279.43	2.44627	FeS_2	119.97	2.07907
Bismuth, Bi	209.00	2.32015	Fe_2S_3	207.87	2.31779
Bi_2O_3	466.00	2.66839	$FeSO_4$	151.80	2.18127
BiOCl	260.46	2.41574	$Fe_2(SO_4)_3$	399.87	2.60192
Bi_2S_3	514.12	2.71112	Lead, Pb	207.20	2.31639
Bromine, Br_2	159.83	2.20366	$PbCl_2$	278.11	2.44422
HBr	80.92	1.90806	$PbCrO_4$	323.21	2.50948
Cadmium, Cd	112.41	2.05080	Pb_3O_4	685.60	2.83607
$CdCl_2$	183.32	2.26321	PbO	223.20	2.34869
CdO	128.41	2.10860	Pb_2O_3	462.40	2.66502
CdS	144.47	2.15978	PbO_2	239.20	2.37876
$CdSO_4$	208.47	2.31904	Pb_2O	430.40	2.63387
Calcium, Ca	40.07	1.60282	$PbSO_4$	303.26	2.48182
$CaCO_3$	100.07	2.00030	Lithium, Li	6.94	0.84136
$CaCl_2$	110.98	2.04524	Li_2CO_3	73.88	1.86853
CaO	56.07	1.74873	LiCl	42.40	1.62737
$CaSO_4$	136.13	2.13395	Li_2O	29.88	1.47538
Carbon, C	12.00	1.07918	Li_3PO_4	115.85	2.06390
CO	28.00	1.44716	Magnesium, Mg	24.32	1.38614
CO_2	44.00	1.64345	$MgCl_2$	95.23	1.97877
C_2N_2	52.02	1.71617	$Mg(NH_4)AsO_4.6H_2O$	289.42	2.46153
HCN	27.02	1.43169	$MgAs_2O_7$	252.24	2.40181
Chlorine, Cl_2	70.91	1.85071	MgO	40.32	1.60557
HCl	36.47	1.56194	MgP_2O_7	222.69	2.34770
Chromium, Cr	52.01	1.71609	$MgSO_4$	120.38	2.08053
$CrCl_3$	158.38	2.19970	Manganese, Mn	54.93	1.73983
Cr_2O_3	152.02	2.18190	MnO	70.93	1.85083
CrO	68.01	1.83257	Mn_2O_3	157.86	2.19827
CrO_3	100.01	2.00004			

MOLECULAR WEIGHTS AND THEIR LOGARITHMS (Cont.)

Compound	Mol. wt.	Log.	Compound	Mol. wt.	Log.
Mn_3O_4	227.79	2.35753	K_2SiF_6	220.25	2.34292
MnS	86.99	1.93947	K_2SO_4	174.26	2.24120
MnS_2	119.06	2.07577	Silicon, Si	28.06	1.44809
$MnSO_4$	150.99	2.17895	SiO_2	60.06	1.77859
$Mn_2(SO_4)_3$	398.05	2.59994	H_2SiF_6	144.08	2.15860
Mercury, Hg	200.61	2.30235	Silver, Ag	107 88	2.03294
HgCl	236.07	2.37304	AgBr	187.80	2.27370
$HgCl_2$	271.52	2.43380	AgCl	143.34	2.15637
HgO	216.61	2.33568	AgCN	133.89	2.12675
Hg_2O	417.22	2.62037	AgI	234.81	2.37072
HgS	232.67	2.36674	Ag_2O	231.76	2.36504
Hg_2S	433.28	2.63677	Ag_3PO_4	418.67	2.62187
Nickel, Ni	58.69	1.76856	$Ag_4P_2O_7$	605.57	2.78216
$NiCl_2$	129.60	2.11260	Sodium, Na	23.00	1.36173
NiO	74.69	1.87326	NaBr	102.91	2.01246
Ni_2O_3	165.38	2.21848	Na_2CO_3	105.99	2.02526
Ni_3O_4	240.07	2.38034	NaCl	58.45	1.76678
NiS	90.75	1.95785	NaOH	40.01	1.60217
$NiSO_4$	154.75	2.18963	NaI	149.93	2.17589
Nitrogen, N_2	28.02	1.44747	Na_2O	61.99	1.79232
NH_3	17.03	1.23121	Na_2SO_4	142.06	2.15247
NO	30.01	1.47727	Strontium, Sr	87.63	1.94265
N_2O_3	76.02	1.88093	$SrCO_3$	147.63	2.16917
N_2O_5	108.02	2.03350	$SrCl_2$	158.54	2.20014
Oxygen, O_2	32.00	1.50515	SrO	103.63	2.01549
O_3	48.00	1.68124	$SrSO_4$	183.69	2.26409
Phosphorous, P_4	124.11	2.09381	Sulfur, S_8	256.51	2.40910
PH_3	34.05	1.53212	H_2S	34.08	1.53250
P_2O_3	110.05	2.04159	SO_2	64.06	1.80659
P_2O_5	142.05	2.15244	SO_3	80.06	1.90342
Platinum, Pt	195.23	2.29055	H_2SO_4	98.08	1.99158
$PtCl_4$	337.06	2.52771	Tin, Sn	118.70	2.07445
Potassium, K	39.10	1.59218	$SnCl_4$	260.53	2.41586
KBr	119.01	2.07558	SnO	134.70	2.12937
KCl	74.55	1.87245	SnO_2	150.70	2.17811
KI	166.03	2.22019	Zinc, Zn	65.38	1.81544
KNO_3	101.10	2.00475	$ZnCl_2$	136.29	2.13446
K_2O	94.20	1.97405	ZnO	81.37	1.91046
KOH	56.10	1.74896	ZnS	97.43	1.98869
K_2PtCl_6	486.16	2.68678	$ZnSO_4$	161.44	2.20801

THE ELEMENTS

Aluminum [L. *alumen*, alum], Al; at. wt. 26.97; at no. 13 m.p. 660° C.; b.p. 1800° C.; sp. gr. 2.70 (20° C.); valence 3 Discovered in 1827 by Wöhler and again in 1854 by St. Clair Deville; the first really practical electrical method of extractio was patented by Cowles in England and the United States i 1885 but this was finally supplanted by methods of Heroult i France and Hall in America; in 1856 the price was about $9 a pound, and in 1928, 24 to 26¢ a pound. Aluminum is no found in the metallic form but occurs as silicate in clays, feldspa etc., and is extracted chiefly from bauxite, an impure hydrate oxide, by electrolysis of the solution in molten cryolit Aluminum is a white, somewhat soft metal resembling tin i appearance; among the metals it stands second in the scale malleability and sixth in ductility. It is but slightly magnetic an is strongly electro-positive, so that in contact with most othe metals it rapidly corrodes; the electrical conductivity is abou 60% that of copper; it is highly sonorous in the bar but has weak, cracked sound when cast into a bell. It takes a hig polish but this is likely to become frosted in appearance due t formation of an oxide coating. Alloys with the following meta have been prepared and used: zinc, copper, magnesium, cerium beryllium, cobalt, tungsten and molybdenum. The com pounds of aluminum of greatest importance are its oxide an its sulfate. The oxide, alumina, occurs naturally as ruby sapphire, corundum and emery and is very hard, ranking nex to the diamond.

Antimony [L. *antimonium*], Sb (stibium); at. wt. 121.77; a no. 51; m.p. 630° C.; b.p. 1380° C.; sp. gr. 6.68(25° C.); valenc 3 or 5. Discovered in 1450 by Valentine. Antimony is metallic element occurring native in rare instances but derive chiefly from *stibnite* or gray antimony ore (Sb_2S_3), *kermesite* red antimony ($2Sb_2S_3.Sb_2O_3$), *valentinite* or white antimon (Sb_2O_3), *senarmontite* (Sb_2O_3), cervantite ($Sb_2O_3.Sb_2O_2$), an certain ores of gold, silver and lead. It is extracted from th sulfide ores by roasting to the oxide which is reduced by sa and scrap iron; from the oxides the metal is also prepared b reduction with carbon. In 1928 the price of antimony wa about 10–11¢ a pound. Antimony is an extremely britt metal of a flaky, crystalline texture, blue-white color and metall lustre; hardness, 3 to 3.5; not acted on by air at room temper ture but when heated it burns brilliantly with the formatio of white fumes of the oxide Sb_2O_3. It is a poor conductor heat or electricity. Its property of expanding on cooling, property which is also found in its alloys makes it useful the preparation of fine and sharp castings. The most importa alloys include type metal, stereotype metal and Babbitt meta The principle compounds of antimony are the sulfides, chlorid and tartar emetic.

Argon [Gr. *argos*, inactive], A; at. wt. 39.91; at. no. 18; m. −189.2° C.; b. p. −185.7° C.; sp. gr. 1.38A; valence 0 (does n combine with any other element); a gas existing in the atmo

phere in the proportion of about 0.8%; it is 2½ times as soluble in water as nitrogen and has approximately the same solubility as oxygen; it is best recognized by the characteristic lines in the red end of the spectrum. Its presence in air was suspected by Cavendish in 1785; discovered by Lord Rayleigh and Sir William Ramsay in 1894. The best known method of obtaining argon on a large scale is from liquid oxygen. It is used as a filler for incandescent electric lamps. The price of argon in 1928 was about $18 per 10 cu. ft.

Arsenic [L. *arsenicum*, Gr. *arsenikon* yellow orpiment (identified with *arsenikos* male, from belief that metals were of different sexes), Arab. *az-zernikh* the orpiment from Persian *zerni* (*zar* gold)], As; at. wt. 74.96; at no. 33; m.p. sublimes (500° C., m.p. under pressure); b.p. 615° C.; sp. gr. 5.73; valence 3 or 5. Discovered in 1694 by Schroder. Arsenic is a steel-gray, very brittle, crystalline, semi-metallic solid, which sublimes on heating, being deposited partly as crystals and partly as a black, amorphous solid; it tarnishes in air and when heated is rapidly oxidized to arsenious oxide (As_2O_3). It is rarely found native occurring mostly as *realgar* (As_2S_2), arsenical iron and mispickel or arsenical pyrites ($FeSA_3$); it is usually prepared by heating mispickel, the arsenic subliming leaving ferrous sulfide. The free element is not considered poisonous (altho many of its compounds are extremely so) and is used in bronzing, pyrotechny and for hardening and improving the sphericity of shot. The most important compounds are white arsenic or arsenious oxide (As_2O_3), cupric arsenite or Paris green ($CuHAsO_3$), and, *orpiment* (As_2S_3). The amorphous form of arsenic has a sp. gr. of 3.70. The price in 1928 was 45–50¢ a pound.

Barium [Gr. *barys*, heavy], Ba; at. wt. 137.37; at. no. 56; m.p. 850° C.; b.p. 1140° C.; sp. gr. 3.5 (20° C.); valence 2. Barium is a metallic element, soft and silvery white like lead; it belongs to the alkaline earth group resembling calcium chemically and is found only in combination with other elements, chiefly in heavy spar (sulfate) and witherite (carbonate) and is prepared by electrolysis. It was discovered by Sir Humphry Davy in 1808. The most important compounds of barium are the peroxide, (BaO_2), chloride ($BaCl_2$), sulfate (permanent white or *blanc fixé*, $BaSO_4$), nitrate ($Ba(NO_3)_2$) and chlorate ($Ba(ClO_3)_2$); the nitrate and chlorate are used in pyrotechny for production of green colors; the sulfate in paint manufacture. The sulfide (BaS) phosphoresces after exposure to light.

Beryllium [L. fr. *beryl;* also called *Glucinum* Gr. *glykys*, sweet], Be or Gl; at. wt. 9.02; at. no. 4; m. p. 1350° C.; b.p. . . .; sp. gr. 1.85; valence 2. Berylliumis a rare metallic element occurring in beryl and other silicates discovered in 1828 by Wöhler. It resembles magnesium in appearance and chemical properties; it may be prepared from its chloride by displacement with sodium. The chief compounds of beryllium are the oxide, nitrate, sulfate, chloride, basic acetate and carbonate.

Bismuth [etymology dubious; Ger. *Wismuth*], Bi; at. wt. 209.00; at. no. 83; m.p. 271° C.; b.p. 1450° C.; sp. gr. 9.78 (20°);

valence 3 or 5. Bismuth is a white, crystalline, brittle metal with a pinkish tinge that occurs in many places free as well as in combination as sulfide, oxide and carbonate; it is extracted from the ore by melting out the free metal, the oxides and sulfides being decomposed by the addition of carbon and iron. It was discovered in 1450 by Valentine. It is a poor conductor of electricity, is very diamagnetic, solidifies with expansion, heated in air it burns with a blue flame forming yellow fumes of the oxide; its soluble salts are characterised by forming insoluble basic salts on the addition of water—a property sometimes used in its detection. Bismuth forms many alloys with metals which are often used for their property of low melting point and because of their expansion on cooling are particularly suited for making sharp castings of objects subject to damage by high temperatures. The important compounds of bismuth are the trioxide (Bi_2O_3), and the subnitrate of medicinal use (*pearl white, pearl powder, blanc de fard* and *blanc d'Espagne*). Bismuth is found native in England, France, Peru, and Siberia, but is mostly obtained from Saxony. The price of the metal in 1928 was \$1.70–2.20 a pound.

Boron [Ar. *būraq*, Pers. *būrah*], B; at. wt. 10.82; at. no. 5; m.p. 2000–2500° C.; b.p. sublimes 2550° C.; sp. gr. of crystals 2.54, of amorphous variety 2.45; valence 3. Boron is an element found in combination in boric acid, native borax or tincal, boracite and several other minerals. Boron is obtained by heating boron trioxide with magnesium powder; it has no commercial value. The element was discovered in 1808 by Sir Humphrey Davy. The most important compounds are boric acid or boracic acid (H_3BO_3), and borax ($Na_2B_4O_7$).

Bromine [Gr. *bromos*, stench], Br; at. wt. 79.916; at. no. 35; m.p. −7.2° C.; b.p. 58.8° C.; sp. gr. of gas 5.87A and of the liquid 3.12 (20°); val. 1, 3, 5 or 7. Bromine, a member of the halogen group of elements, is obtained from natural brines by displacement with chlorine or electrolytically; it is the only liquid non-metallic element, a heavy, mobile, reddish-brown liquid, volatilizing readily at room temperatures to a red vapor with a strong disagreeable odor resembling chlorine and having a very irritating effect on the eyes and throat; it is readily soluble in water or carbon disulfide forming a red solution; it is less active than chlorine but more so than iodine; it unites readily with many elements and has a bleaching action; when spilled on the skin it produces painful sores. It is chiefly employed for the preparation of its compounds which are useful in photography, medicine, coal tar derivatives, etc. The most important compounds are the bromides of sodium and potassium. The element was discovered in 1826 by Balard but it was not prepared in any quantity till 1860. The price in 1928 was about 45¢ a pound.

Cadmium [Gr. *kadmia*, Cadmean (earth)], Cd; at. wt. 112.41; at. no. 48; m.p. 320.9° C.; b.p. 767° C.; sp. gr. 8.65 (20°); valence 2. Cadmium is a soft, bluish-white metal which is malleable and ductile, occurring in small quantities associated with zinc. It comes off before zinc in the preparation of the metal, con-

densing as the brown oxide which is then reduced with carbon. It tarnishes in air and burns when heated forming the oxide. It was discovered in 1817 by Stromeyer. It forms a number of salts of which the sulfate ($CdSO_4$) is the most common. Cadmium is a component of one of the lowest melting alloys and is alloyed with silver in electroplating. The price of cadmium in 1928 was 65–72¢ a pound.

Calcium [L. *calx*, lime], Ca; at. wt. 40.07; at. no. 20; m.p. 810° C.; b.p. 1170° C.; sp. gr. 1.54 (29°); valence 2. Calcium is a metallic element, fifth in abundance in the earth's crust of which it forms 3.5%, an essential constituent in leaves, bones, teeth and shells. It is prepared by electrolysis of the fused chloride. Chemically it is one of the alkaline earth elements; it tarnishes readily in air, reacts with water, burns with a brilliant crimson flame to the oxide and forms many compounds of which the following are the most important: carbide (CaC_2), carbonate in the various forms known as limestone, marble, *calcite*, *aragonite*, stalactites and stalagmites ($CaCO_3$), chloride ($CaCl_2$), cyanamide ($CaCN_2$), fluoride (CaF_2), hydroxide or slaked lime ($Ca(OH)_2$), hypochlorite or bleaching powder ($Ca(ClO)_2$ or $CaClOCl$), nitrate ($Ca(NO_3)_2$), oxide or quick lime (CaO), phosphate or *apatite* ($Ca_3(PO_4)_2$) sulfate or *gypsum* ($CaSO_4$), and sulfide (CaS). It was discovered in 1808 by Davy.

Carbon [L. *carbo*, charcoal], C.; at. wt. 12.000; at. no. 6; m.p. above 3500° C.; b.p. sublimes above 3500° C.; sp. gr. amorphous 1.88, graphite 2.25, diamond 3.51; valence 2 or 4. Carbon, an element of prehistoric discovery is very widely distributed in nature, occurring free as diamond and graphite, and in an impure form as coal; in combination it occurs as carbon dioxide, carbonates and as a constituent of all living things. It occurs in three allotropic forms, the diamond, graphite and amorphous, all forms being solids, insoluble in any common solvent but dissolving in melted metals from which they crystallize on cooling in the form of graphite; when the cooling takes place under pressure some of the carbon is obtained as diamond. Carbon is unique in forming an almost infinite number of compounds, there being at the present time almost one quarter of a million known compounds; the compounds most common are the carbonates, carbon dioxide (CO_2); carbon monoxide (CO), carbon disulfide (CS_2), chloroform ($CHCl_3$), carbon tetrachloride (CCl_4), alcohol (C_2H_6O), acetic acid ($HC_2H_3O_2$) and oxalic acid ($H_2C_2O_4$).

Cerium [Named after the planet *Ceres* which was discovered in 1801 only a short time before the element], Ce; at. wt. 140.25; at. no. 58; m.p. 640° C.; b.p. 1400° C.; sp. gr. 6.90 (20°); valence 3 or 4. Cerium is found in a few rare minerals, *orthite*, *cerite* and the *samarskite* of North Carolina. It is a steel-gray lustrous metal prepared by electrolysis of the chloride. It was discovered by Berzelius in 1803 and is used chiefly as the oxide as an important constituent of incandescent gas mantles.

Caesium [L. *caesius*, sky blue], Cs; at. wt. 132.81; at. no. 55; m.p. 26.4° C.; b.p. 670° C.; sp. gr. 1.87 (26°); valence 1. Caes-

ium is an alkaline metal occurring in lepidolite, pollucite and some mineral springs; it is isolated by electrolysis of the fused cyanide. It was discovered in 1860 by Bunsen in mineral water from Durkheim, in the Palatinate. Caesium is characterized by a spectrum containing two bright lines in the blue along with several others in the red, yellow and green.

Chlorine [Gr. *chloros*, green], Cl; at. wt. 35.457; at. no. 17; m.p. −101.6° C.; b.p. −34.6° C.; sp. gr. gas 2.49 A and 1.56 (−33.6°); valence 1, 3, 5 or 7. Chlorine, a member of the halogen group of elements, is obtained from chlorides by the action of oxidizing agents or by electrolysis; it is a greenish-yellow gas, with an irritating and suffocating odor, attacking the respiratory tract producing symptoms of pneumonia (war gas), combining directly with nearly all elements; in nature it is found in the combined state only, chiefly with sodium as common salt (NaCl), carnallite ($KMgCl_3.6H_2O$) and sylvin (KCl). At 10° C., one volume of water dissolves 2.58 volumes of chlorine while at 25° C. 1.95 volumes of chlorine are dissolved. The most important compounds are the chlorides, hypochlorites and chlorates. The element was discovered by Scheele in 1774. In 1928 the price was about 4¢ a pound.

Chromium [Gr. *chroma*, color], Cr; at. wt. 52.01; at. no. 24; m.p. 1615° C.; b.p. 2200° C.; sp. gr. 6.92 (20°); valence 2, 3 or 6. Chromium is a metallic element resembling iron occurring chiefly in chrome iron ore ($FeOCr_2O_3$) and is prepared by the reduction of the oxide (Cr_2O_3) with aluminum; it is a very infusible, hard, gray metal used to harden steel. The most important compounds are the sodium and potassium chromates (K_2CrO_4), dichromates ($K_2Cr_2O_7$) and the potassium and ammonium chrome alums ($Cr_2(SO_4)_3.K_2SO_4.24H_2O$). It was discovered by Vauquelin in 1797.

Cobalt [G. *Kobold*, goblin or evil spirit], Co; at. wt. 58.94; at. no. 27; m.p. 1480° C.; b.p. 2900° C.; sp. gr. 8.9 (20°); valence 2 or 3. Cobalt is a metallic element occurring in ores which are sparingly distributed; it occurs most frequently in *smaltite* ($CoAs_3$), linnaeite, wad, or cobalt bloom (Co_3S_4) and cobalite or cobalt glance (CoSAs); it is brittle, hard, very magnetic and of a gray color with a reddish tinge. It is used to alloy with other metals and the salts are used chiefly for the production of brilliant and permanent blue colors in porcelain, glass, pottery, tiles, and enamels, being the principle ingredient in *Sevres Blue* and *Thenard's Blue*. It was discovered by Brandt in 1773. The chief compounds are the oxide (CoO), the chloride ($CoCl_2.6H_2O$) and the nitrate ($Co(NO_3)_2.6H_2O$). The price of the metal in 1928 was about $2.50 a pound.

Columbium [*Columbia*, also called Niobium], Cb. or Nb. at. wt. 93.1; at. no. 41; m.p. 1950° C.; b.p. >3300° C.; sp. gr. 8.4; valence 3 or 5. Columbium is a very rare metallic element, occurring chiefly in niobite or columbite; it is prepared by reduction with carbon in the electric furnace and is a gray metal, forming an acid oxide, Cb_2O_5, from which the salts are derived. It was discovered in 1801 by Hatchett.

Copper [L. *Cyprium*], Cu (cuprum); at. wt. 63.57; at. no. 29; m.p. 1083° C.; b.p. 2300° C.; sp. gr. 8.93–8.95; valence 1 or 2. Copper is a metallic element, reddish-colored, bright, metallic luster, malleable, ductile, good conductor of heat and electricity (second to silver in electrical conductivity) occurring native and in various ores: chalcocite (Cu_2S), chalcopyrite ($CuFeS_2$), bornite (Cu_3FeS_3), covelite (CuS), malachite ($CuCO_3.Cu(OH)_2$), azurite ($Cu_3(OH)_2(CO_3)_2$), cuprite (Cu_2O), tenorite (CuO), chrysocolla ($CuSiO_3.2H_2O$), chalcanthite ($CuSO_4.5H_2O$) and tetrahedrite ($4Cu_2S.Sb_2S_3$). It is obtained from the ores by smelting, leaching or electrolysis. The most important compounds are the oxide (CuO) and the sulfate (blue vitriol, $CuSO_4.5H_2O$). The discovery of copper dates from prehistoric times. The price of copper in 1928 was about 13–16¢ a pound.

Dysprosium [Gr. hard to speak with], Dy; at. wt. 162.52; at. no. 66; m.p. .....; b.p. .....; sp. gr. .....; valence 3. Dysprosium is a member of the erbium family of rare earths and occurs in the minerals xenotime, fergusonite, gadolinite, euxonite, polycrase and blomstradine. The free element has never been isolated; it forms highly colored salts. The element was discovered in 1886 by Lecoq de Boisbaudran.

Erbium [*Yrtterby*, a town in Sweden], Er; at. wt. 167.7; at. no. 68; m.p. .....; b.p. .....; sp. gr. .....; valence 3. Erbium is a member of the family of rare earths which includes thulium, erbium, holmium and dysprosium in the order of increasing basicity. It forms highly colored salts and an oxide Er_2O_3. The free element has not been isolated. It occurs in the minerals xenotime, fergusonite, gadolinite, euxonite, polycrase and blomstandine.

Europium [*Europe*], Eu; at. wt. 152.0; at. no. 63; m.p. .....; b.p. .....; sp. gr. .....; valence 3. *See Terbium.* Europium is the most sparsely distributed of the terbium family of rare earths which includes europium, gadolinium and terbium in the order of decreasing basicity. The free element has never been isolated; salts of the type EuX_3 and EuX_2, where X is a univalent atom or radical are known. The general characters of this family resemble those of the cerium family.

Fluorine [L. *fluor*, flow], F; at. wt. 19.00; at. no. 9; m.p. −223° C.; b.p. −187° C.; sp. gr. gas 1.31A of liquid 1.11 (−187°) valence 1. Fluorine, a member of the halogen group of elements, is obtained by electrolyzing a solution of potassium hydrogen fluoride in anhydrous hydrogen fluoride; it is a pale yellow gas, uniting directly with silicon, carbon, hydrogen and nearly all other elements in the dark, decomposes almost all compounds to form fluorides except in the case of oxygen with which it forms no compounds; it occurs chiefly in fluor spar (CaF_2) and cryolite (Na_3AlF_6); the most important compounds are hydrogen fluoride, which is used in etching glass, and calcium fluoride. It was discovered by Scheele in 1771.

Gadolinium [*Gadolin*] Gd; at. wt. 157.26; at. no. 64; m.p. .....; b.p. .....; sp. gr. .....; valence 3. Gadolinium is a member of the terbium family of rare earths

which includes terbium and europium. The general characters of this family resemble those of the cerium family; the free element has never been isolated; the element forms oxides of the type R_2O_3 and its salts are usually more soluble than the corresponding terbium salts. Gadolinium is the most plentiful of the three terbium family elements. These elements decrease in basicity in the order Eu, Gd and Tb.

Gallium [L. *Gallia*, France], Ga; at. wt. 69.72; at. no. 31; m.p. 29.75° C.; b.p. >1600° C.; sp. gr. 5.91 (20°); valence 2 or 3. Gallium is a rare metal belonging to the aluminum group and is the only metallic element besides mercury which can be a liquid at near room temperatures; it is a hard, grayish-white substance and was discovered spectroscopically by Lecoq de Boisbaudran in 1875 in the zinc blende of Pierrefitte, Hautes-Pyrenees altho its occurence was predicted before that time by Mendeleeff who named it eka-aluminum. It forms two sets of chlorides, bromides, iodides, nitrates, sulfates and oxides in which it appears divalent and trivalent.

Germanium [L. *Germania*, Germany], Ge; at. wt. 72.60; at. no. 32; m.p. 958° C.; b.p. volatilizes at 2700° C.; sp. gr. 5.36 (20°); valence 4. Germanium is a metallic element of the silicon group lying between silicon and tin in chemical properties; it is a gray-white, crystalline, brittle metal that retains its luster in air at room temperatures; it is prepared by reducing the oxide obtained from a silver ore (argyrodite) with carbon or with hydrogen. The most important compounds are the oxide (GeO_2) and the halides ($GeCl_4$) the latter being volatile. It was discovered by Winkler in 1886 altho it was predicted before that time by Mendeleeff who named it eka-silicon.

Gold [Anglo-Saxon *gold*], Au (aurum); at. wt. 197.2; at. no. 79; m.p. 1063° C.; b.p. 2600° C.; sp. gr. 19.32 (17.5°); valence 1 or 3. Gold is a metallic element which occurs free, is very widely distributed in nature, occuring principally in rock deposits or in alluvial deposits; it has a yellow color when in mass but when finely divided it may be black, ruby or purple; it is the most malleable and ductile, and also one of the softest of the metals; it is a good conductor of heat and electricity and is not affected by air and most reagents. Its chief use is in coinage and jewelry; the commonest compounds are the auric chloride ($AuCl_3$) and the chlorauric acid ($HAuCl_4$) the latter used in photography for toning the silver image.

Hafnium [*Hafnium*, Copenhagen], Hf; at. wt. 178.6; at. no. 72; m.p. 1700° C.; b.p. > 3200° C.; sp. gr. .....; valence 4. Shortly after Bohr's theory was applied to explaining the periodic system of the elements, G. Urbain announced the identity of missing element number 72 with Celtium which he had discovered in 1911. This identification was based upon the Röntgen spectroscopic observations of A. Dauvilliers. This identity of celtium and element number 72 did not fit the Bohr theory as it should have been closely related to the tetravalent zirconium. With confidence in the Bohr theory, D. Coster and G. von Hevesy in 1922 made a search for element number 72 i

irconium minerals by means of Röntgen spectroscopic analysis nd the first mineral investigated, a zircon from Norway, showed he presence of element number 72 which they named hafnium.)n treatment of the mineral with potassium bifluoride and eparation of K_2ZrF_6, the mother liquors became richer in the mount of the new element. All of the zirconium minerals in- estigated except *polymignite* (Zr-Ti) contained from 1–20% Hf, most of them having it present to the extent of 5% of the irconium content. The mineral *alvite* was found to be par- icularly rich in hafnium. In the range of 2500–3500 A° the ollowing lines were found to be most pronounced: 2761.65, 866.35, 2916.50 and 2940.80. Coster believes that Urbain's eltium is nothing other than a concentrated cassiopeium (lute- ium) preparation. In chemical properties, hafnium resembles irconium. When sodium phosphate is added to a zirconium olution strongly acidified with hydrochloric or nitric acid, a irconium phosphate is precipitated. All other phosphates are oluble in concentrated acid (columbium phosphate is only very lightly soluble) except hafnium which is even less soluble than irconium. Its relative occurence in the earth's crust is esti- nated at $> 2 \times 10^{-5}$.

Helium [Gr. *helios*, the sun] He; at. wt. 4.00; at. no. 2; m.p. $< -271.9°$ C. (26 atm.); b.p. $-268.9°$ C.; sp. gr. 0.137A; valence . H. K. Onnes has cooled the element to the lowest temper- ture ever obtained, $-272.18°$ C.; and expressed the opinion hat helium may remain a liquid even at absolute zero under ormal pressure. In June 1926, Keesom succeeded in pro- lucing solidification at $-271.9°$C. under a pressure of 26 tmospheres. Helium is a gas, inert chemically, obtained by ompression and fractionation of the gas from certain wells nd from the minerals uraninite, cleveite, fergusonite, monazite, horianite and many radio-active minerals. It is the best gas or inflating balloons because of its lightness, being next to ydrogen in this respect, and its non-inflammability. Evi- ence of the existence of helium was first obtained by Sir Norman Lockyer during the eclipse of 1868 when he detected a ew line in the solar spectrum; in 1895 Ramsey isolated helium rom uraninite. The price of helium in 1928 was about $24.25 er 1000 cu. ft.

Holmium [L. *Holmia*, for Stockholm], Ho; at. wt. 163.4; at. no. 7; m.p. .....; b.p. .....; sp. gr. .....; valence 3. Holmium in a member of the erbium family of rare earths which ncludes thulium, erbium, holmium and dysprosium in the order f increasing basicity. It is obtained from xenotime, fergusonite, adolinite, euxenite, polycrase and blomstrandine. The element orms highly colored salts; the free element has never been olated.

Hydrogen [Gr. *hydro*, water, and *genes*, forming], H; at. wt. .008; at. no. 1; m.p. $-259°$ C.; b.p. $-252.8°$ C.; sp. gr. gas .0695A, liquid 0.070($-252°$ C.); valence 1. Hydrogen is a olorless gaseous element occuring chiefly in combination with xygen as water; it is the lightest of all gases, insoluble in water,

uniting with many elements to form compounds; it is used as a reducing agent, as a means of obtaining high temperature flames and for inflating balloons; it is a constituent of all acids, hydroxides and alcohols; it is prepared by the electrolysis of water or by displacement from acids with metals. It was first recognized as a distinct substance in 1766 by Cavendish.

Illinium (University and State of Illinois, U. S. A.) Il; at. wt. estimated 146; at. no. 61; m.p. .....; b.p. .....; sp. gr. ....., valence doubtless 3. Illinium is a member of the cerium group of rare earths which includes lanthanum, cerium, praseodymium, neodymium, illinium, and samarium, in the order of decreasing basicity. It occurs in exceedingly minute traces in monazite, gadolinite, and xenotime. Neither the metal nor its salts have as yet been prepared pure. The discovery of illinium was announced in 1926 by Harris, Yntema and Hopkins, on the basis of absorption, arc, and X-ray emission spectra. Later in the same year Rolla and Fernandez in Italy claimed prior discovery and proposed the name "florentium." The late Charles James, at the University of New Hampshire, concentrated considerable illinium and other investigators have since confirmed the existence of the element.

Indium [From its indigo spectrum], In; at. wt. 114.8; at. no. 49; m.p. 155° C.; b.p. > 1450° C.; sp. gr. 7.28; valence 3. Indium a rare metallic element occuring in some zinc ores; it belongs to the aluminum group in properties, being a very soft, silvery metal, not acted on by water or air, burning to the sesquioxide (In_2O_3) with a blue-violet flame. It was discovered in 1863 by Reich and Richter.

Iodine [Gr. *iodes*, violet], I; at. wt. 126.932; at. no. 53; m.p. 113.5° C.; b.p. above 184.4° C.; sp. gr. gas 8.72 A, solid 4.93 (20°); valence 1, 3, 5 or 7. Iodine, a member of the halogen group of elements, occurs sparingly in the form of iodides in sea water from which it is assimilated by seaweeds, in Chile saltpeter, and in caliche (as sodium iodate); from iodides it is obtained on distillation with sulfuric acid and some oxidizing agent (MnO_2) and from the iodates by heating with sodium bisulfite. It is a grayish-black, lustrous solid, volatilizing at ordinary temperatures into a blue-violet gas with an irritating odor; it forms compounds with many elements but is less active than the other halogens which displace it from iodides; it combines only partly with hydrogen when heated and very little or no action on hydrocarbons; it forms brown solutions with water (slightly soluble) and with alcohol or aqueous potassium iodide; with carbon disulfide, chloroform or carbon tetrachloride purple solutions are obtained. The most important compounds are the iodides of sodium and potassium (KI) and the iodates (KIO_3). It was discovered by Courtois in 1811. The price in 1928 was $4.50 to 5.00 a pound.

Iridium [L. *iris*, rainbow], Ir; at. wt. 193.1; at. no. 77; m.p. 2350° C.; b.p. >4800° C.; sp. gr. 22.42 (17°); valence 3 or 4. Iridium, a metallic element belonging to the platinum family, a very hard, brittle, white metal, occuring in alluvial deposits

long with platinum; it is used in apparatus for high tempera-
ures; alloyed with platinum, it is used for standard weights and
neasures; alloys with osmium are used in tipping pens and com-
pass bearings; iridium black, prepared by exposing alcoholic
olutions of the sulfate to light, is used as a catalytic agent;
he most important salt is the chloride ($IrCl_4$). It was dis-
overed in 1803 by Tennant. The price in 1928 was about $280
n ounce.

Iron [Anglo-Saxon, *iron*], Fe (ferrum); at. wt. 55.84; at. no. 26; m.p. 1535° C.; b.p. 3000° C.; sp. gr. 7.85–7.88; valence 2 or 3. Iron is the most abundant of metals and has been known and used from very early times; the pure metal, which is practically unknown in the Arts (altho some grades of soft steel are almost chemically pure), is silver-white, very ductile and magnetic; the pure metal may be prepared by electric deposition of ferrous sulfate or by reduction of pure oxide with hydrogen or aluminum; pig iron is hard, brittle and fairly fusible, containing about 3% carbon and varying amounts of sulfur, silicon, manganese and phosphorus; wrought iron is tough, grayish-white, and malleable, having usually a fibrous structure, very infusible, with only a few tenths percent or less of carbon; steel is a solid solution of iron carbide in iron with a carbon content usually below 2%. Iron is obtained from the oxide ores by reduction with carbon.

Krypton [Gr. *Kryptos*, hidden], Kr; at. wt. 82.9; at. no. 36; m.p. −169° C.; b.p. −151.8° C.; sp. gr. gas 2.818A; valence 0. Krypton is an inert, rare, gaseous element, occuring in small amounts in the atmosphere, and is characterized by a brilliant green and yellow line in its spectrum. It was discovered in 1895 by Ramsay and Travers. The price of Krypton in 1928 was about $7 per c.c.

Lanthanum [Gr. *lanthano*, to conceal], La; at. wt. 138.90; at. no. 57; m.p. 826° C.; b.p. 1800° C.; sp. gr. 6.155; valence 3. Lanthanum is a metallic element of the rare earths, resembling iron in its physical properties, burning brilliantly in air to form the oxide (La_2O_3); it occurs in the ores cerite, orthite, and monazite; it is prepared from the chloride by treatment with sodium. It was discovered by Mosander in 1837.

Lead [Anglo-Saxon, *lead*], Pb (plumbum); at. wt. 207.20; at. no. 82; m.p. 327.5° C.; b.p. 1620° C.; sp. gr. 11.35; valence 2 or 4. Lead is a metallic element of bluish-white color and bright luster, very soft, highly malleable, slight tenacity, ductile and a poor conductor of electricity; it is obtained chiefly from galena (PbS) by a roasting process. Important lead salts are the nitrate ($Pb(NO_3)_2$), sulfate ($PbSO_4$), acetate ($Pb(C_2H_3O_2)_2$), carbonate ($PbCO_3$), the basic carbonate or *White Lead* ($2PbCO_3 \cdot Pb(OH)_2$). Lead is used in making pipe and containers for corrosive liquids and is a constituent of many useful alloys including solder, type metal and various antifriction metals. Lead salts are used in medicine for washes and lotions because of the astringent properties of the solutions. The price of lead in 1928 was about 6½¢ a pound.

Lithium [Gr. *lithos*, stone], Li; at. wt. 6.940; at. no. 3; m.p.

186° C.; b.p. >1200° C.; sp. gr. 0.534; valence 1. Lithium is a soft, white metal, belonging to the alkali-metal group; it is the lightest metal known; it is widely distributed in combination with other elements occuring in the soil, waters and the minerals lepidolite and spodumene (silicates occuring in California and South Dakota respectively), amblygonite (phosphate). When burned in air it forms the oxide lithia (Li_2O); it also forms a number of salts analogous to the salts of sodium or potassium. The carbonate and citrate are used in medicine to remove uric acid from the body, lithium urate being a soluble salt. It was discovered by Arfvedson in 1817.

Lutecium [*Lutetia*, ancient name of Paris], Lu; at. wt. 175.0; at. no. 71; m.p. .....; b.p. .....; sp. gr. .....; valence 3. It occurs in samarskite and gadolinite; it was discovered in 1907 by Urbain and Welsbach. Lutecium belongs to the ytterbium family of earths which includes ytterbium and lutecium. In 1907 Urbain and in 1908 von Welsbach described a process by which Marignac's ytterbium (1879) could be separated into the two elements ytterbium (neo-ytterbium) and lutecium. Both elements occur in very small amounts in nearly all minerals containing yttrium. The best sources are probably gadolinite, xenotime, polycrase and blomstrandine. The oxide, chloride and sulfate have been prepared.

Magnesium [*Magnesia*, district in Thessaly], Mg; at. wt. 24.32; at. no. 12; m.p. 651° C.; b.p. 1110° C.; sp. gr. 1.74 (20°); valence 2. Magnesium is a light, white, hard and fairly tough metal, occuring very widely distributed in combination as magnesite ($MgCO_3$), dolomite (Mg and Ca carbonate), Epsom salts ($MgSO_4.7H_2O$), carnallite (K and Mg chlorides), kieserite ($MgSO_4.H_2O$) and kanite ($KCl.MgSO_4.3H_2O$). It is obtained by electrolysis of the fused chloride. It tarnishes slightly in air and when in the form of ribbon, wire or powder it ignites on heating, burning with a dazzling white heat. It is useful in flash-light photography, and for pyrotechnic purposes. It is often alloyed with nickel and aluminum; the most important compounds are the oxide (MgO), the sulfate ($MgSO_4$), the chloride ($MgCl_2$) and the citrate ($Mg_3(C_6H_5O_7)_2$). It was discovered in 1829 by Bussy. The price of magnesium in 1928 was 85¢ a pound.

Manganese [L. *magnes*, magnet], Mn; at. wt. 54.93; at. no. 25; m p. 1260° C.; b.p. 1900° C.; sp. gr. 7.2; valence 2, 4, 6 or 7. Manganese is a gray-white metal resembling iron, but harder and very brittle; it is obtained from pyrolusite (MnO_2) and psilomelane ($RO.4MnO_2$, where R is Ba, Li, K or Mn); other ores found in smaller amounts are braunite ($3Mn_2O_3.MnSiO_3$) and manganite ($Mn_2O_3.H_2O$). The metal is obtained by reduction of the oxide with sodium, magnesium, aluminum or by electrolysis. It is used in the production of alloys with iron (spiegeleisen), copper, brass and nickel. The most important compounds are the chloride ($MnCl_2$), sulfate ($MnSO_4$), oxide (MnO), dioxide (MnO_2), and potassium permanganate ($KMnO_4$). It was discovered in 1774 by Gahn.

Masurium [Masurian province belonging to Germany], Ma; at. wt. .....; at. no. 43; m.p. 2300° C.; b.p. .....; sp. gr. .....; valence ..... Masurium is one of the eka-nanganeses discovered by Noddack, Tacke and Berg in 1924 and occurs in the minerals columbite, sperrylite, gadolinite and ergusonite. The element was detected with the aid of the Röntgen spectrum and the relative occurence in the earth's crust is estimated at 10^{-13}.

Mercury [Planet *Mercury*], Hg (hydrargyrum); at. wt. 200.61; at. no. 80; m.p. −38.87° C.; b.p. 356.9° C.; sp. gr. 13.595 (4°); valence 1 or 2. Mercury or quicksilver is a heavy, silver-white, shining liquid, a fair conductor of heat and electricity and has a regular coefficient of expansion; it tarnishes but slightly in air except when heated to near the boiling point where it is slowly converted to the oxide (HgO) from which oxygen is again set free at higher temperatures. It occurs free in nature to a limited extent but the chief source is the sulfide (cinnabar, HgS) from which it is obtained by heating in a current of air. The most important salts are mercuric chloride (corrosive sublimate, $HgCl_2$), mercurous chloride (calomel, HgCl) and mercuric sulfide (vermilion, HgS). Mercury dissolves many metals forming *amalgams* with them. The price of mercury in 1928 was about $1.65 a pound.

Molybdenum [Gr. *molybdos*, lead], Mo; at. wt. 96.0; at. no. 42; m.p. 2620° C.; b.p. 3700° C.; sp. gr. 10.2; valence 3, 4 or 6. Molybdenum is a very hard, silver-white metal which does not occur native being obtained from molybdenite (MoS_2) and from wulfenite ($PbMoO_4$). It is used chiefly in the manufacture of certain grades of tool steel, boiler plate, rifle barrels, and large cranks. It was discovered in 1782 by Hjelm.

Neodymium [Gr. *neos*, new and *didymos*, twin], Nd; at. wt. 144.27; at. no. 60; m.p. 840° C.; b.p. .....; sp. gr. 6.95; valence 3. Neodymium is a metallic element, belonging to the rare earths forming a series of pink salts with a characteristic absorption spectrum. It is one of the components of didymium, occuring in cerite and similar rare minerals. It was discovered in 1885 by Welsbach.

Neon [Gr. *neos*, new], Ne; at. wt. 20.2; at. no. 10; m.p. −248.67.; b.p. −245.9° C.; sp. gr. 0.674A; valence 0. Neon is a gaseous element present in the atmosphere to the extent of one or two parts per 100,000. It is obtained by liquifaction of air and separated from the other elements by fractional distillation. It is an inert element forming no compounds. Neon glows red-orange in a vacuum tube and is marked by pronounced red and green lines in its spectrum. It was discovered by Ramsey and Travers in 1895. The price of neon in 1928 was about $10 per liter.

Nickel [Sw. abbr. of *kupparnickel*], Ni; at. wt. 58.69; at. no. 28; m.p. 1452° C.; b.p. 2900° C.; sp. gr. 8.90; valence 2 or 3. Nickel is a hard, malleable, ductile and tenacious metal, of a white color, somewhat magnetic, a fair conductor of electricity and belonging to the iron-cobalt group of elements. It is

obtained chiefly from the nickeliferous pyrrhotite of Ontario and the garnierite (hydrated silicate of nickel, iron and magnesia found in New Caledonia) by roasting to the oxide which is then reduced by carbon or carbon monoxide. It is chiefly valuable for the alloys which it forms with other metals—nickel steel, German silver (brass and 15–20% Ni), coinage with 75% copper and Monel metal ($2\frac{1}{2}$ parts copper and 1 part Ni); electrodeposition of nickel plate is used as a protective coating for metals. The most important compounds are the sulfate ($NiSO_4$), and the oxides (NiO and Ni_2O_3). Nickel was discovered by Cronstedt in 1751. The price of the metal in 1928 was about 32–35¢ a pound.

Nitrogen [L., niter forming], N; at. wt. 14.008; at. no. 7; m.p. −209.9° C.; b.p. −195.8° C.; sp. gr. 0.967 A and liquid 0.808 (−195.8° C.) solid 1.026 (−252° C.); valence 3 or 5. Nitrogen is a gaseous element which occurs free in the atmosphere of which it forms about four-fifths and from which it can be obtained by liquifaction and fractional distillation. It is easily obtained by heating a water solution of ammonium nitrite (mixture of ammonium chloride and sodium nitrite). It is a colorless, odorless and relatively inert element combining directly with magnesium, lithium and calcium when heated with them. When mixed with oxygen and subjected to electric sparks it forms nitrogen peroxide. It occurs in all living things as an essential ingredient and also occurs in the deposits of salt peter (sodium and potassium nitrate). The chief compounds are the nitrates of many metals, the five oxides (N_2O, NO, N_2O_3, NO_2 and N_2O_5) and ammonia (NH_3). It was first obtained in a pure state by Rutherford, a professor of botany in the University of Edinburgh in 1772 and was first recognized as a distinct element by Lavoisier.

Osmium [Gr. *osme*, odor], Os; at. wt. 190.8; at. no. 76; m.p. 2700° C.; b.p. >5300° C.; sp. gr. 22.48; valence 2, 3, 4 or 8. Osmium is a bluish-white, hard, crystalline metal belonging to the platinum family of elements. It occurs in iridosmine and platinum bearing river sands of the Urals, North America and South America. It is the heaviest known form of matter, is very infusible, oxidizing when heated in the air to the oxide (OsO_4) with a pungent, irritating and poisonous vapor and which is easily reduced by organic matter. Osmium is used in making lamp filaments and with iridium it forms the alloy osmiridium which is used because of its hardness in tipping gold pens and for fine machine bearings. It was discovered in 1803 by Tennant. The price in 1928 was about $78 per ounce.

Oxygen [Gr. acid former], O; at. wt. 16.000; at. no. 8; m.p. −218.4° C.; b.p. −183.0° C.; sp. gr. gas 1.1053A, liquid 1.13; valence 2. Oxygen is a gaseous element which occurs free in the atmosphere of which it forms about one-fifth and from which it can be obtained by liquifaction and fractional distillation; it is also obtained by heating barium peroxide (BaO_2), heating potassium chlorate ($KClO_3$), by electrolysis of water containing a small amount of sulfuric acid and by adding sodium peroxide (Na_2O_2) to water. The critical temperature and pressure are −118° C. and 50 atmospheres. Gaseous oxygen is colorless,

odorless and tasteless; the liquid and solid forms are a pale blue color and are magnetic but much less so than iron. Oxygen is very reactive, capable of combining with all elements except the inert elements of the atmosphere and bromine and fluorine. Under suitable conditions it may be converted into an allotropic form known as ozone (O_3). It is used in combination with combustible gases in the oxygen blow pipes and flames; in medicine it is used to aid respiration. It was discovered in 1774 by Priestley.

Palladium [Planet *Pallas*], Pd; at. wt. 106.7; at. no. 46; m.p. 1555° C.; b.p. 2200° C.; sp. gr. 12.0; valence 2 or 4. Palladium is a steel-white metal, belonging to the platinum family of elements; it is obtained in working up platinum with which it occurs native. It does not tarnish in air and has the property of absorbing large volumes of hydrogen to form the hydride (Pd_2H). It is used in the construction of non-magnetic watches and parts of delicate balances. The most important compound is the chloride ($PdCl_2$). It was discovered in 1804 by Wollaston. The price of the metal in 1928 was about $46 an ounce.

Phosphorus [Gr. *light bearing*], P; at. wt. 31.027; at. no. 15; m.p. 44.1° C.; b.p. 280° C.; sp. gr. yellow 1.82, red 2.20; valence 3 or 5. Phosphorus occurs in three allotropic forms—*viz.* yellow, red and black. Though never found free in nature, it is widely distributed in combination in minerals, the most important being the apatites ($3Ca_3(PO_4)_2CaF_2$ and $3Ca_3(PO_4)_2 CaCl_2$) which are the chief ingredients of commercial phosphates derived from South Carolina, Canada and Spain; it is an essential ingredient of all cell protoplasm, nervous tissue and bones. It is obtained from phosphates by treatment with dilute sulfuric acid to form o-phosphoric acid, the concentrated solution of which is mixed with crushed charcoal or coke and dried; on heating this mixture in retorts, the phosphorus distils and is condensed. It is also prepared by heating crude phosphate with coke in the electric furnace when the phosphorus distils off. Ordinary phosphorus is a waxy solid which is colorless when very pure, insoluble in water and soluble in carbon disulfide; it takes fire spontaneously in air burning to the pentoxide; it is very poisonous; when heated in its own vapor to 250° it is converted into the red variety which does not glow in air and which does not ignite spontaneously and is not poisonous. The most important compounds are the pentoxide or phosphoric anhydride (P_2O_5), the chlorides (PCl_5 and PCl_3) and the phosphates of the alkali metals. It was discovered in 1669 by Brandt. The price of the yellow and red varieties in 1928 were about 34¢ and 60¢ a pound respectively.

Platinum [Sp. *platina*], Pt; at. wt. 195.23; at. no. 78; m.p. 1755° C.; b.p. 4300° C.; sp. gr. 21.45; valence 2 or 4. Platinum is a tin-white metal of metallic luster, tenacious, malleable and ductile, occuring native in alluvial deposits or in rock forming minerals found principally in the Ural mountains, in Colombia, in California, Oregon, Arizona and Alaska. It is welded at a red heat, has a coefficient of linear expansion approximately equal to

that of glass; does not oxidize in air at any temperature but is corroded by halogens, cyanide, sulfur and caustic alkalies; it forms alloys with lead; it has a catalytic effect of bringing about combination of hydrogen with water and sulfur dioxide and oxygen. The most important compound is chloroplatinic acid (H_2PtCl_6). It was discovered in 1741 by Wood. The price of platinum in 1928 was around $76 an ounce.

Potassium [Eng. *potash*], K (kalium); at. wt. 39.096; at. no. 19; m.p. 62.3°C.; b.p. 760° C.; sp. gr. 0.86; valence 1. Potassium is a soft, bright silvery metal belonging to the alkali group; it is never found free but is obtained by electrolysis of the hydroxide (KOH). On exposure to moist air it becomes coated with a film of the oxide (K_2O) and is preserved by immersing in kerosene or naphtha. The principal sources of potassium are: the mines of Strassfurt in Prussian Saxony from the minerals *kainite* ($MgSO_4.KCl.3H_2O$), *sylvin* (KCl) and *carnallite* ($KCl.MgCl_2.6H_2O$); crude potassium carbonate or potash obtained by extraction of wood ashes; potassium salts from natural brines, from cement mill and blast furnace dust, from kelp, from alkali lakes in Nebraska and Searles Lake, California. The chief compounds of potassium are the hydroxide, the carbonate (K_2CO_3), nitrate (KNO_3), chloride (KCl), chlorate ($KClO_3$), bromide (KBr), iodide (KI), cyanide (KCN), sulfate (K_2SO_4), dichromate ($K_2Cr_2O_7$), chromate (K_2CrO_4) and silicate (K_2SiO_3). It was discovered in 1807 by Davy and was the first metal to be isolated from an earth by the electric current.

Praseodymium [Gr. *praseos*, green, and *didymos*, twin], Pr; at. wt. 140.92; at. no. 59; m.p. 940° C.; b.p. .....; sp. gr. 6.5 (20°); valence 2. Praseodymium is a metallic element belonging to the group of rare earths; it is a one of the constituents of didymium and is found in cerite. It forms green salts with a characteristic absorption spectrum. It was discovered in 1885 by Welsbach.

Radium [L. *radius*, ray] Ra; at. wt. 225.95; at. no. 88; m.p. 960° C.; b.p. 1140° C.; sp. gr. 5(?); valence 2. Radium is a brilliant white metal obtained in 1911 by Mme. Curie and Debierne by the electrolysis of a pure solution of radium chloride, employing a mercury cathode; the amalgam on distillation in an atmosphere of hydrogen yielded the pure element. The metal alters very rapidly in contact with air, decomposes water and is somewhat more volatile than barium. In the form of a salt it was first isolated by M. and Mme. Curie in 1898 from the pitchblende in North Bohemia in which it occurs in about one part in three million. The carnotite sands of Colorado yield about 2% uranium nitrate, the amount of radium in uranium is one part in 3,200,000. Radium is obtained commercially as the bromide or the chloride. The primary uses of radium are in producing self-luminous paints and in the treatment of cancer and certain types of skin affections. One gram of radium produces about 100 cubic millimeters of emanation per day, this is pumped from the radium, and sealed in minute tubes, which are then applied to the diseased parts. Radium loses about 1%

of its activity in 25 years being transformed into elements of lower atomic weight.

Rhenium [Rhine province belonging to Germany], Re; at. wt. .....; at. no. 75; m.p. 3000° C.; b.p. .....; sp. gr. .....; valence ..... Rhenium or dwimanganese is one of the eka-manganeses discovered in 1924 by Noddack, Tacke and Berg in the minerals columbite, tantalite and wolframite. The element was detected with the aid of the Röntgen spectrum and the relative occurrence in the earth's crust is estimated at 10^{-12}.

Rhodium [Gr. *rhodon*, rose], Rh; at. wt. 102.91; at. no. 45; m.p. 1955° C.; b.p. > 2500° C.; sp. gr. 12.5; valence 3. Rhodium is a silver-white metallic element belonging to the platinum family, occurring native with other members of this group in river sands in the Urals and in North and South America. The salts form red solutions. An alloy with platinum is used in connection with pure platinum, to make the thermojunctions in some forms of pyrometers. It was discovered in 1804 by Wollaston. The price in 1928 was about $71 per ounce.

Rubidium [L. *rubidus*, red), Rb; at. wt. 85.44; at. no. 37; m.p. 38.5° C.; b.p. 700° C.; sp. gr. 1.53; valence 1. Rubidium is a soft, white, rare metallic element of the potassium group occurring in small quantities in the mineral waters of Dürkheim in Rhenish Palatinate, in lepidolite and in the rare minerals castor and pollux found in Elba. It is prepared by the electrolysis of the cyanide, forms salts similar to potassium and colors the flame red when held in a burner. It was discovered in 1860 by Bunsen.

Ruthenium [*Ruthenia*, Russia], Ru; at. wt. 101.7; at. no. 44; m.p. 2450° C.; b.p. > 2700° C.; sp. gr. 12.2; valence 3, 4, 6, or 8. Ruthenium is a hard, brittle, gray metal belonging to the platinum group, occurring native with the other metals of this group; it forms red or brown salts; ruthenious chloride ($RuCl_3$) gives a characteristic fine black precipitate with water. It was discovered in 1845 by Claus. The price in 1928 was about $69 per ounce.

Samarium [*Samarski*, a Russian], Sm; at. wt. 150.43; at. no. 62; m.p. 1300–1400° C.; b.p. .....; sp. gr. 7.7–7.8; valence 3. Samarium is a metallic element belonging to the rare earth group occurring in very minute quantities in samarskite, cerite and certain Scandinavian minerals. It was discovered by Boisbaudran in 1879.

Scandium [*Scandinavia*], Sc; at. wt. 45.10; at. no. 21; m.p. 1200° C.; b.p. 2400° C.; sp. gr. 2.5 (?); valence 3. Scandium is a metal belonging to the rare group which has not been isolated in the elementary form; it forms colorless salts derived from the oxide Sc_2O_3. It was discovered by Nilson in 1879.

Selenium [Gr. *selene*, moon], Se; at. wt. 79.2; at. no. 34; m.p. 220° C.; b.p. 688° C.; sp. gr. 4.47–4.80; valence 2, 4, or 6. Selenium is a gray, crystalline, semi-metallic appearing element of the sulfur group. The principal source is the flue dust obtained in burning pyrites in the manufacture of sulfuric acid.

It is prepared in a red, amorphous form by reduction of selenic acid and this on melting and keeping somewhat below the melting point becomes crystalline. Its conductivity for electricity increases with the brightness of the light with which it is illuminated. The compounds of selenium resemble those of sulfur very closely. It was discovered in 1817 by Berzelius.

Silicon [L. *silex*, flint], Si; at. wt. 28.06; at. no. 14; m.p. 1420° C.; b.p. 2600° C.; sp. gr. 2.42; valence 4. Silicon is a non-metallic element resembling graphite in appearance; it is not found free but in combination is probably more widely distributed in the solid matter of the earth than any other element except oxygen. It occurs chiefly as the oxide, silica (SiO_2) (quartz, rock crystal, amethyst, agate, flint, jasper, opal, etc.) both free and in combination with the metallic oxides as silicates (granite, hornblende, asbestos, feldspar, clay, mica, etc.). It is obtained as an amorphous, brown powder on fusion of potassium fluosilicate with sodium or potassium; the crystalline form is obtained by passing silicon tetrachloride over melted aluminum in an atmosphere of hydrogen or by heating potassium fluosilicate with zinc and sodium at a temperature just below the boiling point of zinc. Silicon is not attacked by acids with the exception of a mixture of nitric and hydrofluoric acids; it is soluble in hot caustic potash or soda, evolving hydrogen and forming the corresponding silicate (K_2SiO_3 or Na_2SiO_3). It was first prepared by Berzelius in 1823.

Silver [Anglo-Saxon, *soelfor*], Ag (argentum); at. wt. 107.880; at. no. 47; m.p. 960.5° C.; b.p. 1950° C.; sp. gr. 10.50; valence 1. Silver is a pure white metal having a brilliant luster, a little harder than gold and is excelled only by that metal in malleability and ductility; it excells all other metals as a conductor of heat and electricity; silver undergoes no change in water or pure air, but absorbs about 22 times its volume of oxygen when melted which is again expelled on cooling; it tarnishes in the vapors of sulfur compounds forming the sulfide (Ag_2S). It occurs native and in many ores, the chief ones being argentite (Ag_2S), stephanite (Ag_5SbS), pyragyrite (Ag_3SbS) and horn silver (AgCl); lead and copper ores yield considerable silver. Silver is obtained from the ores by smelting with lead or copper or by amalgamation with mercury. The most important compounds of silver are the nitrate ($AgNO_3$ or lunar caustic), the oxide (Ag_2O), and the halides (AgCl, AgBr) which darken on exposure to light an action of which is made use of in photography. The price of the metal in 1928 was about 59¢ an ounce.

Sodium [English, *soda*], Na (natrium); at. wt. 22.997; at. no. 11; m.p. 97.5° C.; b.p. 880° C.; sp. gr. 0.971; valence 1. Sodium is a soft, bright silvery metal belonging to the alkali group; it is never found free but is obtained by electrolysis of the hydroxide. On exposure to moist air it becomes coated with a film of the oxide and is preserved by immersing in kerosene or naphtha. It is very widely distributed in combination chiefly as common salt or sodium chloride. It decomposes water with the formation of hydrogen and the hydroxide of sodium; it burns in air

ith the formation of the peroxide (Na_2O_2); formerly it was sed as a reducing agent in the preparation of metals (alumi-um and magnesium); it is still used for the reduction of organic ompounds, in the preparation of the peroxide and cyanide, and r keeping the mercury clean and active in gold extraction. he chief compounds are the chloride (NaCl), bromide (NaBr), dide (NaI), carbonate (Na_2CO_3), bicarbonate ($NaHCO_3$), sul-te (Glaubers salt $Na_2SO_4.10H_2O$), nitrate (saltpeter $NaNO_3$), trite ($NaNO_2$), sulfite ($Na_2SO_3.7H_2O$), thiosulfate (hypo, $a_2S_2O_3.5H_2O$), borate (borax $Na_2B_4O_7.10H_2O$) and hydroxide NaOH). It was first isolated in 1807 by Davy.

Strontium [*Strontian*, town in Scotland], Sr; at. wt. 87.63; . no. 38; m.p. 800° C.; b.p. .....; sp. gr. 2.6; valence 2. trontium is a hard, yellowish metal belonging to the calcium roup found chiefly in celestine ($SrSO_4$) and strontianite $SrCO_3$). It is prepared by electrolysis of the fused chloride nd resembles metallic calcium in its properties; the salts are enerally soluble in water with the exception of the sulfate, nosphate and carbonate; they impart a brilliant crimson color the flame and are used in pyrotechny for red fire. The most nportant salts are the bromide ($SrBr_2$), iodide (SrI_2), and rbonate ($SrCO_3$). The element was first obtained by Davy 1808.

Sulfur [L. *sulfur*], S; at. wt. 32.064; at. no. 16; m.p. rhombic 12.8° C., monoclinic 119.0° C.; b.p. 444.6° C.; sp. gr. rhombic 07; monoclinic 1.957; valence 2, 4, or 6. Sulfur occurs widely stributed in nature in the free form in Alabama, California, olorado, Georgia, Idaho, Kentucky, Louisiana, Nevada, New lexico, Tennessee, Texas, Utah, Wyoming and Sicily. In mbination it occurs mostly as pyrites; sulfides of iron (FeS_2), ipreous and arsenical pyrites; sulfides of lead (galena), zinc lende), mercury (cinnabar) and antimony (stibnite); it is also idely distributed in the form of the sulfates of calcium (gyp-m), strontium (celestine), magnesium (Epsom salt) and rium (heavy spar). It is not practically obtained from the lfates but is mined as native sulfur or molten underground superheated steam, pumped up and allowed to solidify. It purified by precipitation or sublimation. Sulfur is a pale llow, odorless, brittle solid, which is insoluble in water and luble in carbon disulfide. It occurs in two crystalline forms d an allotropic form known as plastic sulfur which is insoluble carbon disulfide and which reverts to the crystalline form on anding; a finely divided form known as flowers of sulfur is tained by sublimation. It readily forms compounds known sulfides with many elements. Sulfur is chiefly employed for e preparation of sulfur dioxide, for fumigation, for the prepa-tion of sulfur dioxide, for fumigation, for the preparation of lfuric acid, as a component of gunpowder and as a parasiticide. is easily ignited in air-burning to form the dioxide; it is a good ectrical insulating material. The price of sulfur in 1928 was om 2¢ to 15¢ a pound depending upon the quality.

Tantalum [Gr. *tantalus*, myth], Ta; at. wt. 181.5; at. no. 73;

m.p. 2850° C.; b.p. > 4100° C.; sp. gr. 16.6; valence 5. Tant
lum was discovered in 1802 by Ekeberg and occurs principally
the mineral Tantalite ($FeTa_2O_6$) and is prepared by reduction
potassium fluorotantalate (K_2TaF_7) with hydrogen followed b
fusion in a vacuum. It can be drawn into a wire with a ve
high point of fusion and great tenacity which has been use
in the construction of filaments for incandescent electric lamp
It is also used to alloy with other metals. It is soluble in fus
alkalis, insoluble in acids and forms the oxide Ta_2O_5.

Tellurium [L. *tellus*, earth]. Te; at. wt. 127.5; at. no. 5
m.p. 452° C.; b.p. 1390° C.; sp. gr. 6.24; valence 4 or 6. Te
lurium was discovered by Reichenstein in 1782 and occurs
gold telluride and with some copper ores. It is obtained b
reduction of telluric oxide and forms a powder of grayish whi
metallic appearance. It is a semi-metallic element of the sulf
group and forms tellurides with hydrogen and metals similar
the sulfides; the compounds H_2TeO_3 and H_2TeO_4 are on
slightly acid. The inhalation of the vapors of tellurium co
pounds produces the very offensive "tellurium breath
Tellurium is used in ceramics.

Terbium [*Ytterby*, town in Sweden], Tb; at. wt. 159.2; at. n
65; m.p. .....; b.p. .....; sp. gr. .....; valence
Terbium was discovered by Mosander in 1843. It occurs
gadolinite and in the majority of ceria and yttria minera
The terbium family of rare earths includes europium, gado
nium and terbium. None of the metals of the terbium fami
have been isolated. The general characters of this fami
resemble those of the cerium family. Among the rare eart
the decrease in basicity is in the order Sa, Eu, Gd, Tb, D
The elements are all trivalent and yield colorless oxides of t
type R_2O_3, altho terbium alone furnishes the higher oxide Tb_4O
The salts of terbium are generally less soluble than those
gadolinium. These salts are of the type RX_3 where X is
univalent atom or radical. Europium also forms salts of t
type EuX_2. Europium is most sparsely distributed a
gadolinium the most plentiful of these elements.

Thallium [Gr. *thallos*, budding twig], Tl; at. wt. 204.39; at. n
81; m.p. 303.5° C.; b.p. 1650° C.; sp. gr. 11.85; valence 1 or
Thallium, a metallic element, discovered by Crookes in 18
occurs in pyrites and is prepared from the flue dust of sulfu
acid works. The metal is obtained by heating thallium iodi
with metallic sodium; it resembles lead having a hardn
of 1.2 compared with 1.5 for lead; the malleability is high a
the tenacity is low; it exists in two allotropic forms with a tran
tion temperature of 226° C.; it is a poor conductor of electrici
tarnishes in air forming the oxide Tl_2O or the hydroxide TlOH
the presence of water; the element is displaced from solutio
of its salts by zinc. Thallium salts are poisonous and have
commercial application.

Thorium [God *Thor*], Th; at. wt. 232.15; at. no. 90; m
1845° C.; b.p. > 3000° C.; sp. gr. 11.2; valence 4. Thori
was discovered by Berzelius in 1828 and occurs chiefly in thor

id other rare minerals. In the U. S. it is obtained chiefly from onazite which contains from 3 to 9 per cent of the oxide. The ee element has been obtained by heating the double chloride fluoride of thorium and potassium with metallic sodium or otassium. The element belongs to the tin group of metals. horium burns brightly in oxygen to form the oxide ThO_2 which also obtained on heating the nitrate, a reaction which is made e of in the preparation of incandescent gas mantles. Thorium its radiations similar but not identical with those of radium.

Thulium [*Thule*, Northland], Tm; at. wt. 169.4; at. no. 69; .p. .....; b.p. .....; sp. gr. .....; valence 3. Thu- im discovered in 1879 by Cleve belongs to the erbium family the rare earths which includes dysprosium, holmium, erbium id thulium. They are characterized by their absorption ectra and the formation of highly colored salts; they form asic oxides of the type M_2O_3 with the following order of creasing basicity; thulium, erbium, holmium and dysprosium. hey are obtained from xenotime, fergusonite, gadolinite, xonite, polycrase and blomstrandine. The free elements ave not been isolated.

Tin [Anglo-Saxon, *tin*], Sn (stannum); at. wt. 118.70; at. no. ; m.p. 231.9° C.; b.p. 2260° C.; sp. gr. gray, 5.75 at 20°; rhom- c, 6.55; tetragonal, 7.31 at 20°; valence 2 or 4. Tin is found iefly in the mineral cassiterite (SnO_2) and is obtained by roast- g to remove sulfur and arsenic, and smelting with powdered nthracite in a reverbatory furnace. It is a silver white, mal- able and somewhat ductile metal with a low tenacity and ghly crystalline structure; it takes a high polish and is used to at other metals to prevent corrosion as it does not corrode sily in air. When heated in air it forms the dioxide (SnO_2) hich is feebly basic forming stannate salts with basic oxides. he most important compound is the chloride ($SnCl_2,2H_2O$) hich is used as a reducing agent and as a mordant in calico- inting. Tin is obtained chiefly from the Malay states, olivia, Banka, Billiton, Cornwall and Australia. The price the metal was from 48¢ to 58¢ per pound in 1928.

Titanium [L. *Titanes*, sons of the earth], Ti; at. wt. 48.1; . no. 22; m.p. 1800–1850° C.; b.p. > 3000° C.; sp. gr. 4.5; lence 3 or 4. Titanium was discovered by Gregor in 1789; it a metallic element of the tin group which occurs naturally as e oxide (TiO_2) as rutile, brookite and anastase; it occurs also various titanates, and with many iron ores. The free element prepared by heating the oxide with aluminum or by electroly- of the solution of the oxide in calcium chloride. It is a strous white metal which burns in air and is the only element hich burns in nitrogen. The most important compounds are e oxide (TiO_2) which is feebly acidic and from which the anates are derived; the halides (TiX_4) are volatile liquids, the rides (Ti_2N_2, Ti_3N_4) are metallic in appearance. It is used th steel to increase the tensile strength; most of the metallur- al titanium of the U. S. comes from the rutile of Virginia. he price of titanium oxide in 1928 was about 40¢ a pound.

Tungsten [Sw. heavy stone], W (wolframium); at. wt 184.0; at. no. 74; m.p. 3400° C.; b.p. .....; sp. gr. 18.7 valence 6. Tungsten, a metallic element, discovered by d'Elhu jar in 1781, occurs in the form of the oxide (WO_3) in wolframite hubnerite, scheelite. The free element is obtained by fusion c tungsten disulfide and calcium oxide in a graphite crucible b means of the electric arc. It is hard, brittle, nonmagnetic an forms the oxide when heated in air. The only solvent for tung sten is a mixture of nitric and hydrofluoric acids. It form alloys with iron and manganese and imparts hardness to stee It is used to make filaments for incandescent electric lamps.

Uranium [Planet *Uranus*], U; at. wt. 238.17; at. no. 92 m.p. near Mo at a bright red heat; b.p. .....; sp. gr. 18.68 valence 4 or 6. Uranium was discovered by Klaproth in 1789 it occurs in pitchblende (as uranous uranate $U(UO_4)_2$). Th free element is prepared by reduction of uranous chloride (UCl with sodium and is a hard white metal; uranium is used chiefl in the form of the compounds which give a canary-yello fluorescent glass, a black pigment for china painting and i photography. Uranium compounds emit rays although th property may be due to radium which contaminates th uranium.

Vanadium [Goddess *Vanadis*], V; at. wt. 50.96; at. no. 23 m.p. 1710° C.; b.p. 3000° C.; sp. gr. 5.96; valence 3 or 5. Vana dium is a rare metallic element discovered by Sefström i 1830 and occurs in mettramite (a lead-copper vanadate) an vanadinite (a lead vanadate); the free element is obtained b reduction of the chloride in hydrogen forming a gray and ver infusible metal. When alloyed with steel it increases the hard ness. The vanadates are employed in the preparation o aniline black and for coloring glass.

Xenon [Gr. *xenos*, strange], Xe; at. wt. 130.2; at. no. 54 m.p. –140° C.; b.p. –109.1° C.; sp. gr. 4.422 (A); sp. gr. 3.0 (–109.1°), valence 0. Xenon was discovered by Ramsay an Travers in 1895 in the residue left on evaporating liquid ai It is the rarest and heaviest of the gases of the argon family an is present in the atmosphere to the extent of about one part i twenty million. It is inert and forms no compounds with oth elements. The price of xenon in 1928 was about $15 per c.c

Ytterbium [*Ytterby*, in Sweden], Yb; at. wt. 173.6; at. n 70; m.p. .....; b.p. .....; sp. gr. .....; valen 3. The ytterbium family of earths includes ytterbium an lutecium of which very little is known, both of which have be obtained from the ytterbium separated by Marignac in 187 In 1907 Urbain and in 1908 von Welsbach described a proce by which this ytterbium could be resolved into two element —neo-ytterbium, or simply ytterbium, and lutecium. The elements occur in nearly all the minerals which contain yttriu but in very small amounts. The best sources are probab gadolinite, xenotime, polycrase and blomstandine. T oxides, chlorides and sulfates of these elements have be prepared.

Yttrium [*Ytterby*, in Sweden], Y; at. wt. 88.9; at. no. 39; m.p. 1490° C.; b.p. 2500° C.; sp. gr. 3.8; valence 3. Yttrium is a metallic element belonging to the rare earths. Yttria was discovered by Gadolin in 1794 and in 1842 Mosander showed that yttria could be resolved into three others, the name yttria being reserved for the most basic one, the others were named erbia and terbia. Wöhler obtained the free element by reduction of the chloride with potassium; it has also been obtained by electrolysis of a mixture of the chloride and sodium chloride. The metal forms small scales with a metallic luster and an iron-gray color; it is readily oxidized in air and is converted to the hydroxide by boiling water. Yttrium occurs in nearly all the rare earths but mostly in gadolinite, xenotime, euxonite, polycrase and samarskite.

Zirconium [Per. *argun*, gold color], Zr; at. wt. 91.00; at. no. 40; m.p. 1700° C.; b.p. > 2900° C.; sp. gr. 6.4; valence 4. Zirconium was discovered by Berzelius in 1824 and occurs as the silicate in zircon and hyacinth. It is prepared from the fluorine-potassium compound by displacement with aluminum or sodium and forms silvery grey scales or an amorphous black powder. The oxide has been used in the preparation of incandescent gas mantles, in paints and lacquers, in insulators, as an abrasive and colored varieties of the naturally occurring silicates are used as gems. The price of the pure oxide in 1925 was about 45¢ to 60¢ per pound.

Zinc [G. *Zink*], Zn; at. wt. 65.38; at. no. 30; m.p. 419.4° C.; b.p. 907° C.; sp. gr. 7.14 (20°); valence 2. Zinc is a metallic element occurring in nature only in combination with other elements. The principle ores are the sulfide (sphalerite, or blende), the carbonate (smithsonite), the oxide (zincite), the silicates (willemite and calamine). It is a bluish-white metal which is brittle at ordinary temperatures but becomes malleable at 100° C., a fair conductor of electricity and burns in air at a high red heat with evolution of white clouds of the oxide. It is used to alloy with other metals—e. g., with copper it forms brass. Galvanizing consists in coating other metals with zinc to prevent corrosion. It is used as the negative electrode in various types of electric batteries. The most important compounds are the oxide, the sulfate and the chloride. The price of the metal in 1928 was about 6¢ to 7¢ per pound.

PHYSICAL CONSTANTS OF

The following table gives data for over two thousand compounds. It is intended to include all inorganic compounds concerning which definite information is available.

The molecular weights are computed to the nearest hundredth from the atomic weights of 1925.

Specific gravities are given for definite temperatures where possible, the temperature in degrees Centigrade being indicated by the small figures appearing in the position of an exponent. Unless otherwise indicated the values are referred to water at 4° C. The figures $5.63^{25}_{18}{}^{\circ}$ indicate a specific gravity of 5.63 at 20° C. referred to water at 15° C.

In all cases where temperatures are not stated ordinary room temperatures may be understood (15–25° C.).

Boiling points are given at atmospheric pressure unless otherwise indicated.

Solubilities have been given in definite figures and the temperatures stated, where possible, in the same form as for specific gravity. The solubility is indicated as grams of the substance in 100 c.c. of the solvent except where the *volume* of the substance is indicated by abbreviation c.c. or vol.

The following abbreviations are employed: —

a.	acid	aq.	aqua, water
acet.	acetone	aq. reg.	aqua regia
acet. a.	acetic acid	asym.	asymmetrical
al.	alcohol	atm.	atmospheres
alk.	alkali	bl.	blue
amor.	amorphous	blk.	black
appr.	approximately	br.	brown

	Name	Formula	Mol. wt.	Crystalline form and color
1	Acetic acid	$HC_2H_3O_2$	60.03	liq., colorl.
2	Aluminum	Al	26.97	octahdr., silvery
3	acetate, normal	$Al(C_2H_3O_2)_3$	204.04	wh. powd.
4	acetate, basic	$Al(C_2H_3O_2)_2OH$	162.03	amor., wh.
5	arsenate	$AlAsO_4$	165.93	
6	bromate	$Al(BrO_3)_3.9H_2O$	572.86	cryst.
7	bromide	$AlBr_3$	266.72	
8	bromide	$AlBr_3.6H_2O$	374.81	colorl. cryst.
9	carbide	Al_4C_3	143.88	yel., hex.
10	chlorate	$Al(ClO_3)_3.6H_2O$	385.44	rhbdr.
11	chloride	$AlCl_3$	133.34	wh. powd.
12	chloride	$AlCl_3.6H_2O$	241.44	
13	fluoride	AlF_3	83.97	
14	fluoride	$Al_2F_6.7H_2O$	294.05	wh. cryst. powd.
15	hydroxide	$Al(OH)_3$	77.99	wh., amor.
16	iodide	AlI_3	407.77	brown* cryst.
17	iodide	$AlI_3.6H_2O$	515.86	white
18	nitride	Al_2N_2	81.96	yel. cryst.
19	nitrate	$Al(NO_3)_3.9H_2O$	375.14	rhombic
20	oxide	Al_2O_3	101.94	hex., amor., white
21	oxide	$Al_2O_3.H_2O$	119.16	trimetric
22	oxide	$Al_2O_3.2H_2O$	137.97	amor.
23	phosphate	$AlPO_4$	122.00	hex., amor., white
24	potassium tartrate	$KAl(C_4H_4O_6)_2$	362.13	

* Due to free iodine.

NORGANIC COMPOUNDS

hl.	chloroform
olorl.	colorless
one.	concentrated
ryst.	crystalline
l.	decomposes
lec.	decomposes
eliq.	deliquescent
il.	dilute
lk.	dark
th.	ether
x.	excess
el.	gelatinous
lyc.	glycerine
r.	gray
rn.	green
.	hot
ex.	hexagonal
yg.	hygroscopic
	insoluble
nd.	indigo
t.	light
q.	liquid
net.	metallic
neth.	methyl
nin.	mineral
monocl.	monoclinic
need.	needles
octahdr.	octahedral
or.	orange
pa.	pale
pl.	plates
powd.	powder
pr.	prisms
reg.	regular
rhomb.	rhombic.
rhbdr.	rhombohedral
s.	soluble
sl.	slightly
subl.	sublimes
tabl.	tablets
tetrag.	tetragonal
tricl.	triclinic
trim.	trimetric
volt.	volatilizes
v.	very
wh.	white
yel.	yellow
∞	soluble in all proportions
>	greater than
<	less than

	Sp. Gr. $H_2O = 1$ (A) air = 1 (D) H_2 = 1	Melting-point, Deg. C.	Boiling-point, Deg. C.	Solubility in 100 parts of		
				Cold water	Hot water	Alcohol, acids, etc.
1	1.0607$^{4°}_{4°}$	16.7	118.1	∞	∞	s. al.
2	2.71	658.7	1800	i.	i.	s. alk.; s. HCl, H_2SO_4
3		d.		s.	dec.	
4		d.		i.		s. a.; i. NH_4 salts
5				i.	i.	sl. s. a.
6		62.3	d. 100	hyg.		
7	2.54	93	263.3$^{747mm.}$	s.		s. CS_2, al.
8				deliq.	s.	s. CS_2, al.
9	2.36			dec. to CH_4		s. a.
0		d.		v. s.	v. s.	
1		190, 2½ atm.	182.7$^{752mm.}$	69.87$^{15°}$	s.	s. chl., CCl_4, eth., CS_2
2				40	v. s.	s. eth.; 50 al
3	3.10			s.	s.	
4		$-4H_2O$, 120	$-6H_2O$, 250	i.	sl. s.	
5	2.42	$-2H_2O$, 300		i.	i.	s. a.; s. alk.
6	2.63	185	360	s.		
7				v. s.	v. s.	s. al., CS_2
8		2150		dec. slowly		s. alk.
9		73	d. 134	v. s.	v. s., dec.	s. al., CS_2
0	3.75–4.00	2050		i.	i.	s. alk., H_2SO_4, HCl
1	3.43			i.	i.	i. a., alk.
2				i.	i.	i. a., alk.
3	2.54–.59			i.	i.	s. a., alk.; i acet. a.
4				s.	s.	

PHYSICAL CONSTANTS OF

	Name	Formula	Mol. wt.	Crystalline form and color
1	Aluminum sodium chloride	$AlCl_3.NaCl$	191.80	
2	sodium fluoride	$AlF_3.3NaF$	209.96	
3	sulfate	$Al_2(SO_4)_3$	342.13	cryst., wh.
4	sulfate	$Al_2(SO_4)_3.18H_2O$	666.42	monocl. colorl.
5	sulfide	Al_2S_3	150.13	hex. need. yel.
6	Alum, ammonium	$Al_2(SO_4)_3.(NH_4)_2SO_4.24H_2O$	906.66	Colorl. cryst.
7	ammonium, chrome	$Cr_2(SO_4)_3.(NH_4)_2SO_4.24H_2O$	956.74	octahdr. grn. or violet
8	ammonium, iron	$Fe_2(SO_4)_3.(NH_4)_2SO_4.24H_2O$	964.40	reg. violet
9	caesium	$Al_2(SO_4)_3.Cs_2SO_4.24H_2O$	1136.20	
10	potassium	$Al_2(SO_4)_3.K_2SO_4.24H_2O$	948.77	regular
11	potassium, chrome	$Cr_2(SO_4)_3.K_2SO_4.24H_2O$	998.85	reg., green
12	potassium, iron	$Fe_2(SO_4)_3.K_2SO_4.24H_2O$	910.45	reg., violet
13	potassium, manganese	$Mn_2(SO_4)_3.K_2SO_4.24H_2O$	909.63	reg., violet
14	rubidium	$Al_2(SO_4)_3.Rb_2SO_4.24H_2O$	1041.46	
15	sodium	$Al_2(SO_4)_3.Na_2SO_4.24H_2O$	916.57	regular
16	thallium	$Al_2(SO_4)_3.Tl_2SO_4.24H_2O$	1279.36	
17	Ammonia	NH_3	17.03	colorl. gas
18	Ammonium acetate	$NH_4C_2H_3O_2$	77.06	wh. hyg. cryst.
19	antimonate	$NH_4SbO_3.2H_2O$	223.84	cryst.
20	auricyanide	$Au(CN)_3.NH_4CN.H_2O$	337.29	plates
21	aurocyanide	$AuCN.NH_4CN$	267.26	
22	arsenate	$(NH_4)_2AsO_4.3H_2O$	247.13	
23	arsenite	NH_4AsO_2	125.00	prisms
24	benzoate	$NH_4C_7H_5O_2$	139.08	colorl. cryst.
25	borofluoride	NH_4BF_4	104.86	hex. prisms
26	bromide	NH_4Br	97.96	reg., colorl.
27	bromoplatinate	$(NH_4)_2PtBr_6$	710.81	red reg.
28	carbonate	$(NH_4)_2CO_3.H_2O$	114.10	pl., colorl.
29	carbonate, acid	NH_4HCO_3	79.05	rhomb. or monocl.
30	carbonate, carbamate	$NH_4HCO_3.NH_4CO_2NH_2$	157.11	wh. cryst.
31	carbonate, sesqui	$(NH_4)_2CO_3.2NH_4HCO_3.H_2O$	272.20	
32	chloraurate	$(NH_4AuCl_4)_4.5H_2O$	1518.35	yel. monocl.
33	chlorate	NH_4ClO_3	101.50	monocl.
34	chloride	NH_4Cl	53.50	tetrag.
35	chloroiridate	$(NH_4)_2IrCl_6$	441.92	reddish br.
36	chloropalladate	$(NH_4)_2PdCl_6$	355.52	br. red
37	chloropalladite	$(NH_4)_2PdCl_4$	284.61	olive grn. need.
38	chloroplatinate	$(NH_4)_2PtCl_6$	444.05	yel. reg.
39	chloroplatinite	$(NH_4)_2PtCl_4$	373.14	tetrag.
40	chlorostannate	$(NH_4)_2SnCl_6$	367.52	
41	chromate	$(NH_4)_2CrO_4$	152.09	monocl. yel.
42	citrate	$(NH_4)3C_6H_5O_7$	243.16	wh. powd.
43	cyanate	NH_4CNO	60.05	
44	cyanide	NH_4CN	44.05	regular

INORGANIC COMPOUNDS (Continued)

	Sp. Gr. $H_2O = 1$ (A) air = 1 (D) $H_2 = 1$	Melting-point, Deg. C.	Boiling-point, Deg. C.	Solubility in 100 parts of		
				Cold water	Hot water	Alcohol, acids, etc.
1	.....	185	.....	s.	s.	
2	2.9–3.08	.....	.....	sl. s.	.....	i. HCl
3	$2.672^{23.5°}$	d. 770	.....	$36.1^{20°}$	$89.1^{100°}$	
4	1.62	d.	.....	$86.85^{0°}$	$1132^{100°}$	i. al.
5	$2.02^{1\frac{1}{3}3°}$	1100	.....	dec.	.....	s. a.
6	$1.645^{2\frac{2}{4}0°}$	94.5	$-20H_2O$, 120; $-24H_2O$, 200	$3.9^{0°}$	$357^{100°}$	i. al.
7	1.719	.....	.....	$3.95^{0°}$, $15^{15°}$	.....	s. al.
8	1.712	.....	.....	$40^{15°}$	$400^{100°}$	i. al.
9	$2.021^{0°}$	117	.....	$0.4241^{0°}$	$31.36^{100°}$	
0	$1.757^{2\frac{8}{4}0°}$	92	$-18H_2O$, 64.5	$5.2^{0°}$	$422^{100°}$	
1	$1.8128^{0°}$	89	.....	20	50	i. al.
2	1.806	.....	.....	$20^{12.5°}$	v.	i. al.
3	.....	.....	.....	dec.		
4	1.87	99	.....	$1.3^{8°}$	$43.25^{80°}$	
5	$1.675^{2\frac{8}{4}0°}$	61-5	.....	$103.1^{10°}$	$146.3^{30°}$	i. al.
6	2.32	.....	.....	$4.84^{0°}$	$65.19^{60°}$	
7	(A) 0.5971 Liq. $0.6234^{0°}$	−77.34	−38.5	$89.9^{0°}$g $104,960$ c.c.	$7.4^{100°}$g $58,594^{25°}$ c.c.	$14.8^{20°}$ al.; s. eth.
8	.....	89	.....	$148^{4°}$		
9	.....	d.	.....	i.		
0	.....	d. 200	.....	s.	v. s.	i. al.
1	.....	d. 150–200	.....	s.	.....	s. alk.
2	.....	.....	.....	s.		
3	.....	.....	.....	v. s.	.....	s. aik.
4	.....	d. 193	.....	$19.6^{14.5°}$	$83.3^{100°}$	$3.57^{25°}$, $13.2^{78°}$ al.
5	$1.851^{17°}$	.....	.....	s.		
6	$2.227^{1\frac{5}{4}0°}$	subl.	.....	$68^{100°}$	$145.6^{100°}$	s. al., eth.
7	$4.265^{2\frac{4}{4}0°}$	d.	.....	$0.59^{20°}$		
8	.....	d. 85	.....	$100^{15°}$	.....	i. al.
9	1.586	d. 36–60	.....	$11.9^{0°}$	$27^{30°}$	i. al.
0	.....	subl.	.....	$25^{15°}$	$67^{65°}$	
1	.....	d.	.....	$25^{13°}$	$50^{49°}$	
2	.....	$-5H_2O$, 100	.....	s.	.....	s. al.
3	.....	expl. 102	.....	s.	.....	s. al.
4	$1.52^{17°}$	d. 350	.....	$29.4^{0°}$	$77.3^{100°}$	sl. s. al. NH_3, meth. al.
5	2.856	.....	.....	$0.71^{4°}$	$2.8^{69°}$	
6	2.418	d.	.....	s.		
7	.....	d.	.....	v. s.	.....	i. al.
8	$3.034^{2\frac{4}{4}0°}$	d.	.....	$0.67^{20°}$	$1.25^{100°}$	0.005 al.
9	.....	d.	.....	s.	v. s.	
0	2.511	.....	.....	$33.33^{15°}$		
1	$1.866^{11°}$	d. 180	.....	$40^{30°}$	dec.	
2	.....	.....	.....	s., deliq.		
3	.....	d.	.....	s.	dec.	sl. s. al.
4	.....	d. 36	.....	s.	v. s.	s. al.

	Name	Formula	Mol. wt.	Crystalline form and color
1	Ammonium dichromate	$(NH_4)_2Cr_2O_7$	252.10	monocl. orange
2	dithionate	$(NH_4)_2S_2O_6$	196.21	monocl.
3	ferric oxalate	$(NH_4)_3Fe(C_2O_4)_3.4H_2O$	446.02	lt. grn. cryst.
4	ferrocyanide	$(NH_4)_4Fe(CN)_6.6H_2O$	392.14	monocl.
5	fluoride	NH_4F	37.04	hex.
6	fluoride acid	$NH_4F.HF$	57.05	rhombic
7	fluosilicate	$(NH_4)_2SiF_4$	140.14	
8	formate	NH_4CHO_2	63.05	monocl.
9	gallate	$NH_4C_7H_5O_5.H_2O$	205.10	
10	hypophosphite	$NH_4H_2PO_2$	83.08	rhombic tabl.
11	iodate	NH_4IO_3	192.97	rhombic
12	iodide	NH_4I	144.97	regular
13	magnesium arsenate	$MgNH_4AsO_4.6H_2O$	289.42	tetrag.
14	magnesium phosphate	$MgNH_4PO_4.6H_2O$	245.48	tetrag.
15	metavanadate	NH_4VO_3	117.00	cryst.
16	molybdate	$(NH_4)_2MoO_4$	196.08	monocl.
17	molybdate, hepta-	$(NH_4)_6Mo_7O_{24}.4H_2O$	1236.30	monocl. colorl.
18	nitrate	NH_4NO_3	80.05	rhomb. or tetrag. colorl.
19	nitrite	NH_4NO_2	64.05	yel. liq.
20	oxalate	$(NH_4)_2C_2O_4.H_2O$	142.10	trimet. pr.
21	oxalate, acid	$NH_4HC_2O_4.H_2O$	125.06	trimet. pr.
22	perchlorate	NH_4ClO_4	117.50	rhombic
23	perchromate	$(NH_4)_3CrO_8$	234.13	red, octahdr.
24	permanganate	NH_4MnO_4	136.97	rhombic
25	persulfate	$(NH_4)_2S_2O_8$	228.21	monocl.
26	phosphate, di-	$(NH_4)_2HPO_4$	132.12	monocl., colorl.
27	phosphate, meta-	$(NH_4)_4P_4O_{12}$	388.27	tetrag.
28	phosphate, mono-	$NH_4H_2PO_4$	115.08	tetrag.
29	phosphite	$NH_4H_2PO_3$	99.08	colorl. deliq.
30	phosphomolybdate	$(NH_4)_3PO_4.12MoO_3.3H_2O$	1931.20	yellow
31	salicylate	$NH_4C_7H_5O_3$	155.08	monocl.
32	selenate	$(NH_4)_2SeO_4$	179.28	rhombic or monocl.
33	stannic chloride	$(NH_4)_2SnCl_6$	367.52	reg.
34	sulfate	$(NH_4)_2SO_4$	132.14	rhomb., colorl.
35	sulfate, acid	NH_4HSO_4	115.11	rhombic
36	sulfide	$(NH_4)_2S$	68.14	
37	sulfide, penta-	$(NH_4)_2S_5$	196.40	or.-red pr.
38	sulfite	$(NH_4)_2SO_3.H_2O$	134.16	monocl. colorl.
39	sulfite, acid	NH_4HSO_3	99.11	rhombic
40	sulfhydrate	NH_4HS	51.11	rhombic, colorl.
41	sulfocyanate	NH_4CNS	76.11	monocl. colorl.
42	tartrate	$(NH_4)_2C_4H_4O_6$	184.11	colorl. monocl.
43	tartrate, acid	$NH_4HC_4H_4O_6$	167.08	colorl.
44	thiocarbonate	$(NH_4)_2CS_3$	144.27	yellow
45	thiosulfate	$(NH_4)_2S_2O_3$	148.21	rhombic
46	tungstate, meta-	$(NH_4)_2W_4O_{13}.8H_2O$	1124.21	octahdr.
47	tungstate, para-	$(NH_4)_6W_7O_{24}.6H_2O$	1888.34	rhombic
48	Antimonic acid, meta-	$HSbO_3$	170.78	
49	Antimonic acid, ortho-	H_3SbO_4	188.79	

INORGANIC COMPOUNDS (Continued)

	Sp. Gr. $H_2O = 1$ (A) air = 1 (D) H_2 = 1	Melting-point, Deg. C.	Boiling-point, Deg. C.	Solubility in 100 parts of		
				Cold water	Hot water	Alcohol, acids, etc
1	2.367	d.	.....	$47.1^{30°}$	v. s.	
2	1.704	.....	.....	v. s.	.....	i. al.
3	$1.779^{17°}$	$-3H_2O$, 100	d. 165	$42.8^{0°}$	$345^{100°}$	
4	.....	.....	.....	s.	.....	i. al.
5	.....	.....	.....	v. s.	dec.	sl. s. al.
6	$1.211^{\frac{1}{12}°}$	.....	.....	v. s.		
7	.....	.....	.....	$18.5^{17.5°}$		
8	1.266	d.	.....	$102^{0°}$	$531^{80°}$	
9	.....	.....	.....	s.		
10	.....	100	.....	s.	s.	v. s. al.
11	3.31–.34	d. 150	.....	$2.6^{15°}$	$14.5^{100°}$	
12	2.515	subl.	d.	v. s.	v. s.	v. s. al.
13	.....	.....	.....	$0.038^{20°}$	s.	i. al.; s. a.
14	1.65	.....	.....	0.0132	.....	i. al.; s. a.
15	.....	d.	.....	sl. s.	v. s.	i. NH_4Cl
16	2.38–.95	d	.....	dec.	dec.	i. al.
17	.....	.....	.....	s.		
18	$1.725^{15°}$	153–66	d. 210	$118^{0°}$	$871^{100°}$	$3.8^{20°}$ al.
19	1.69	d.	.....	s.	dec.	s. al.
20	1.502	.....	.....	$4.2^{18°}$	41.34	
21	1.556	.....	.....	s.		
22	1.95	d.	.....	s.	v. s.	
23	.....	d. 50	.....	sl. s.	.....	sl. s NH_3; i. al., eth.
24	2.208	d.	.....	$8^{15°}$		
25	.....	d.	.....	$58.2^{0°}$		
26	1.619	.....	.....	25	.....	i.
27	.....	.....	.....	s.		
28	$1.803^{1\frac{1}{4}°}$	.....	.....	$171^{0°}$	$260^{21°}$	
29	.....	123	d. 150	s.		
30	.....	.....	.....	$0.03^{15°}$	i.	i. al., HNO_3; s. alk.
31	.....	.....	.....	$111^{25°}$	s.	$43.5^{25°}$, $100^{78°}$ al.
32	$2.197^{18°}$	d.	.....	$117^{0°}$	$197^{100°}$	
33	2.511	.....	.....	33		
34	$1.769^{2\frac{0}{4}°}$	*513 d.	d. 140	$71^{0°}$	$103^{100°}$	i. al.
35	1.787	146.9	.....	100		
36	.....	dec.	.....	v. s.		
37	.....	.....	.....	s.		
38	.....	d.	.....	$100^{12°}$	.....	i. al.
39	.....	d.	.....	s.		
40	.....	d.	.....	v. s.	.....	s. al.
41	$1\ 305^{13°}$	159	d. 170	$122^{0°}$	$162^{20°}$	s. al.
42	1.601	.....	.....	s.	s.	
43	1.680	.....	.....	sl. s.	.....	i. al.; s. a., alk.
44	.....	subl.	.....	v. s.	.....	i. al., eth.
45	.....	.....	.....	s.		
46	.....	$-7H_2O$, 100	.....	120	.....	i. al., eth.
47	.....	$-4H_2O$, 100	.....	$2.8^{15°}$	$4.5^{22°}$	
48	6.6	d.	.....	sl. s.	sl. s.	s. a., KOH
49	6.6	d.	.....	sl. s.	sl. s.	

* Under pressure.

PHYSICAL CONSTANTS OF

	Name	Formula	Mol. wt.	Crystalline form and color
1	Antimonic acid, pyro-	$H_4Sb_2O_7$	358.57	
2	Antimonous acid	H_3SbO_3	172.79	
3	Antimony	Sb	121.77	hex. rhomb. white
4	bromide (butter of Sb)	$SbBr_3$	361.52	rhombic
5	chloride, tri-	$SbCl_3$	228.14	rhombic
6	chloride, penta-	$SbCl_5$	299.06	liq.
7	fluoride, tri-	SbF_3	178.77	octahdr.
8	fluoride, penta-	SbF_5	216.77	oily, liq.
9	hydride (stibene)	SbH_3	124.79	gas
10	iodide, tri-	SbI_3	502.57	hex., rhomb., monocl., red-yel.
11	oxide, tri-	Sb_2O_3	291.54	rhombic or regular
12	oxide, tetra-	Sb_2O_4	307.54	white
13	oxide, penta-	Sb_2O_5	323.54	yellow
14	oxychloride (ous)	$SbOCl$	173.23	monocl., white
15	oxychloride (ic)	$SbOCl_3$	244.14	yellow
16	sulfate	$Sb_2(SO_4)_3$	531.73	wh. powd.
17	sulfide, tri-	Sb_2S_3	339.73	hex. black
18	sulfide, penta-	Sb_2S_5	403.86	orange
19	Antimonyl potassium tartrate	$K(SbO)C_4H_4O_6.\frac{1}{2}H_2O$	333.91	octahdr.
20	sulfate, basic	$(SbO)_2SO_4.Sb_2(OH)_4$	683.18	
21	sulfate, normal	$(SbO)_2SO_4$	371.60	
22	Arsenic cryst.	As_4	299.84	gray rhbdr.
23	Arsenic amorphous	As_4	299.84	black
24	acid, meta-	$HAsO_3$	123.97	
25	acid, ortho-	$H_3AsO_4.\frac{1}{2}H_2O$	150.99	
26	acid, pyro-	$H_4As_2O_7$	265.95	
27	fluoride	AsF_5	169.96	gas
28	iodide, di-	AsI_2	328.82	
29	pentoxide	As_2O_5	229.92	amor.
30	sulfide, di- (realgar)	As_2S_2	213.05	monocl. red
31	sulfide, penta-	As_2S_5	309.24	yellow
32	Arsenous bromide	$AsBr_3$	314.71	prisms
33	chloride	$AsCl_3$	181.33	need., oily liq.
34	fluoride	AsF_3	131.96	oily liq.

INORGANIC COMPOUNDS (Continued)

	Sp. Gr. $H_2O = 1$ (A) air = 1 (D) H_2 = 1	Melting-point, Deg. C.	Boiling-point, Deg. C.	Solubility in 100 parts of		
				Cold water	Hot water	Alcohol, acids, etc.
	.....	$-H_2O$, 200	.....	sl. s.	sl. s.	s. KOH
	.....	d.	.....	i.	i.	i. al.
	6.62$^{20°}$	630	1440	i.	i.	s. h. conc. H_2SO_4, aq. rg.
	4.148$^{23°}$	94.2	280	dec.	dec.	s. HCl, HBr, CS_2, al.
	3.064$^{26°}$	73.2	223.5	601.6$^{0°}$	4531$^{80°}$	s. al., HCl, $H_2C_4H_4O_6$
	2.346$\frac{2}{3}^{0°}$	−6	102^{68mm}	dec.	dec.	s. HCl
	4.379$^{21°}$	292	subl.	21.3$^{0°}$	31.3$^{30°}$	
	2.990$^{23°}$	.....	155	s.	.....	s. KF
	(A) 4.344$^{15°}$	−91.5	−18, d. 150	20 cc.	4 c.c.	1500 c.c. al., 2500 c.c. CS_2
	4.848$^{26°}$	170.8	401	dec.	dec.	s. al., HI, HCl, KI, CS_2
	3.70–.72, 5.2–.6	.....	1550	0.00182$^{15°}$	0.01	s. HCl, KOH, $H_2C_4H_4O_6$
	3.8–4.0	O, 1060	.....	i.	i.	s. HCl, KOH, HI; sl. s. a.
	3.78	O, 450	2O 1060	i.	i.	s. HCl, KOH, HI
	.....	.....	.....	i.	dec.	i. al.; s. HCl, CS_2
	.....	d.	.....	i.	dec.	s. al.
	4.89	d.	.....	dec.	dec.	s. H_2SO_4
	4.62	555	.....	0.000175	dec.	s. alk., NH_4HS, K_2S, HCl
	4.120$^{0°}$	.....	.....	i.	i.	s. alk., NH_4HS, HCl
	2.6	$-\frac{1}{2}H_2O$, 100	.....	5.26$^{8.7°}$	35.7$^{100°}$	i. al.; s. glyc.
	.....	.....	.....	i.	dec.	5.15$^{15°}$ glyc.
	4.89	.....	.....	dec.	dec.	
	5.727$^{14°}$	subl.*	.....	i.	i.	s. HNO_3
	3.69	.....	.....	i.	i.	s. HNO_3, Cl_2. H_2O, aq. reg., hot alk.
	.....	d.	.....	Forms orth	o arsenic ac	id
	2.00–.50	35.5	$-H_2O$, 160	16.7	50	s. alk.
	.....	d. 206	.....	Forms orth	o arsenic ac	id
	(D) 5.964	−80	−53	s.	.....	s. alk., al., eth.
	.....	d.	.....	.....	.....	s. al., eth., CS_2, chl.
	4.086	.....	d.	150	v. s.	s. alk.
	3.55	307	565	i.	i.	s. K_2S, $NaHCO_3$
	.....	.....	subl.	i.	i.	s. alk., HNO_3
	3.66$\frac{1}{3}^{0°}$	31	221	dec.	dec.	s. HBr, HCl
	2.205$\frac{2}{3}^{0°}$	−18	130.2	dec.	dec.	s. HBr, HCl
	2.73	−8.5	63	dec.	dec.	s. al., eth.

* Melts at 500° under pressure, sublimes without melting 446–457.

	Name	Formula	Mol. wt.	Crystalline form and color
1	Arsenous hydride (arsine)	AsH_3	77.98	gas
2	iodide	AsI_3	455.76	red, hex
3	oxide	As_2O_3	197.92	reg., amor. white
4	oxychloride	$AsOCl$	126.42	
5	phosphide	AsP	105.99	brown
6	selenide	As_2Se_3	387.52	
7	sulfide (orpiment)	As_2S_3	246.11	monocl. yel. or red.
8	Auric, *see gold*			
9	Barium	Ba	137.37	yellowish metal
10	acetate	$Ba(C_2H_3O_2)_2.H_2O$	273.43	prisms
11	arsenate	$Ba_3(AsO_4)_2$	690.83	black
12	arsenate, acid	$BaHAsO_4.H_2O$	295.35	white cryst.
13	boride	BaB_6	202.29	black reg.
14	bromate	$Ba(BrO_3)_2.H_2O$	411.22	monocl.
15	bromide	$BaBr_2$	297.20	
16	bromide	$BaBr_2.2H_2O$	333.23	monocl.
17	butyrate	$Ba(C_4H_7O_2)_2.2H_2O$	341.51	
18	carbide	BaC_2	161.37	gray crystals
19	carbonate	$BaCO_3$	197.37	rhombic, white
20	chlorate	$Ba(ClO_3)_2.H_2O$	322.30	monocl.
21	chloride	$BaCl_2$	208.28	
22	chloride	$BaCl_2.2H_2O$	244.32	rhombic
23	chloroplatinate	$BaPtCl_6.4H_2O$	617.41	monocl. red
24	chloroplatinite	$BaPtCl_4.3H_2O$	528.48	
25	chromate	$BaCrO_4$	253.38	rhombic yel. pl.
26	citrate	$Ba_3(C_6H_5O_7)_2.7H_2O$	916.30	
27	cyanide	$Ba(CN)_2$	189.39	
28	dichromate	$BaCr_2O_7$	353.39	red monocl. pr.
29	dichromate	$BaCr_2O_7.2H_2O$	389.42	yel. need.
30	dithionate	$BaS_2O_6.2H_2O$	333.53	rhombic
31	ferrocyanide	$Ba_2Fe(CN)_6.6H_2O$	594.72	yel. monocl.
32	fluoride	BaF_2	175.37	wh. powd.
33	fluosilicate	$BaSiF_6$	279.43	
34	fluobromide	$BaBr_2.BaF_2$	472.57	plates
35	fluochloride	$BaCl_2.BaF_2$	383.65	plates
36	fluoiodide	$BaI_2.BaF_2$	566.60	plates
37	formate	$Ba(CHO_2)_2$	227.39	monocl.
38	hexanitride	$BaN_6.H_2O$	239.43	cryst.
39	hydride	BaH_2	139.39	cryst.
40	hydroxide	$Ba(OH)_2.8H_2O$	315.51	tetrag. wh.
41	hypophosphate	$BaPO_3$	216.40	need.
42	hypophosphite	$Ba(H_2PO_2)_2.H_2O$	285.47	monocl.
43	iodate	$Ba(IO_3)_2.H_2O$	505.25	monocl.
44	iodide	$BaI_2.2H_2O$	427.27	rhombic
45	malate	$BaC_4H_4O_5$	269.40	

INORGANIC COMPOUNDS (Continued)

Sp. Gr. $H_2O = 1$ (A) air = 1 (D) $H_2 = 1$	Melting-point, Deg. C.	Boiling-point, Deg. C.	Solubility in 100 parts of		
			Cold water	Hot water	Alcohol, acids, etc.
(A)2.695	−113.5	−54.8, d. 230	5.1 vol.	sl. s.	sl. s. alk.
$4.39^{\frac{15}{15}}$°	140.7	394–414	.....	30^{100}°	s. al., eth.
3.65–4.15	218 subl.	.....	1.2006^{20}°	2.038^{25}°	s. alk., alk. carb., HCl, al.
.....	.....	.....	dec.	dec.	
.....	.....	.....	dec.	dec.	s. CS_2; i. al., eth.
4.75	360	.....	i.	dec.	s. alk.
3.46	310	>700	0.00005	sl. s.	s. alk., alk. carb.
3.78	850	950	dec.	dec.	s. al., a.
2.02	d.	.....	6.9°	80.5^{99}°	i. al.
.....	.....	.....	0.055	.....	s. a., NH_4Cl
.....	$-H_2O$, 150	$-1\frac{1}{2}H_2O$,225	i.	i.	s. HNO_3
4.36^{15}°	.....	.....			
3.82	d.	.....	0.3°	5.67^{100}°	
$3.852^{\frac{4}{4}}$°	$-2H_2O$, 100	d.	125°	181.7^{100}°	v. s. meth. al.
$4.781^{\frac{4}{4}}$°	880	d.	98°	149^{100}°	
.....	.....	.....	37.42°	42.12^{80}°	
3.75	.....	.....	d. to C_2H_2	.....	d. a.
4.275	d. $-CO_2$	.....	0.0022^{20}°	0.0065^{100}°	i. al.; s. a., NH_4Cl
3.179	414	.....	19.2^{3}°	111.2^{100}°	sl. s. al.
$3.856^{\frac{4}{4}}$°	955	.....	30.9°	62.7^{100}°	i. al.; sl. s. HCl, HNO_3
$3.097^{\frac{4}{4}}$°	$-2H_2O$, 100	.....	36.2^{0}°	73.5^{100}°	
2.86	.....	.....	s.	.....	d. a.
2.868	.....	.....	s.	.....	v. s. 93% al.
4.498^{15}°	.....	.....	0.00035^{18}°	0.0043	s. HCl, HNO_3
.....	.....	.....	0.0406^{18}°	.....	sl. s. al.
.....	.....	.....	80^{14}°	.....	18^{14}° al.
.....	.....	.....	sl. s.	.....	s. h. conc. H_2SO_4
.....	.....	.....	dec.		
5.6	.....	.....	24.75^{18}°	90.9^{100}°	
.....	.....	.....	0.1^{15}°	1^{75}°	
4.828	1280	.....	0.163^{18}°	sl. s.	s. a., NH_4Cl
4.28^{15}°	.....	.....	0.026^{17}°	0.09^{100}°	i. al.; sl. s. HCl, NH_4Cl
4.96.	.....	.....	dec.	dec.	i. al.; s. conc. HCl, HNO_3
4.51^{18}°	.....	.....	dec.	dec.	
5.21	.....	.....	dec.	dec.	
3.212	.....	.....	27.76^{0}°	39.71^{80}°	i. al., eth.
.....	expl.	.....	v. s.	v. s.	
4.21^{00}	.....	1400	dec.	dec.	
1.356	80; $-7H_2O$, 95°	108; $-8H_2O$, 780	5.56^{15}°	182.7^{80}°	s. al.; i. eth.
.....	.....	.....	sl. s.	.....	s. al.
2.875	.....	.....	29	33	i. al.
5.23	$-H_2O$, 130	.....	0.008^{0}°	0.21^{100}°	i. al.; s. HCl, HNO_3
$5.150^{\frac{4}{4}}$°	$-2H_2O$, 539; 740	.....	170°	272^{100}°	v. s. al.
.....	.....	.....	0.883^{20}°	1.044^{80}°	

	Name	Formula	Mol. wt.	Crystalline form and color
1	Barium malonate	$BaC_3H_2O_4.H_2O$	257.40	
2	manganate	$BaMnO_4$	256.30	green, hex.
3	metatungstate	$BaW_4O_{13}.9H_2O$	1243.51	tetrag.
4	nitrate	$Ba(NO_3)_2$	261.39	reg.
5	nitrite	$Ba(NO_2)_2.H_2O$	247.40	hex. need.
6	oxalate	$BaC_2O_4.H_2O$	243.39	
7	oxide	BaO	153.37	amor.
8	oxide	BaO	153.37	regular
9	perchlorate	$Ba(ClO_4)_2$	336.28	hex.
10	permanganate	$Ba(MnO_4)_2$	375.23	
11	peroxide	BaO_2	169.37	gray
12	peroxide	$BaO_2.8H_2O$	313.50	grayish white
13	persulfate	$BaS_2O_8.4H_2O$	401.56	prisms
14	phosphate, di-	$BaHPO_4$	233.41	rhombic need.
15	phosphate, mono-	$BaH_4(PO_4)_2$	331.46	tricl.
16	phosphate, pyro-	$Ba_2P_2O_7$	448.79	rombic, wh.
17	phosphate, tri-	$Ba_3(PO_4)_2$	602.16	
18	platinocyanide	$BaPt(CN)_4.4H_2O$	508.70	gray to yel. monocl
19	propionate	$Ba(C_3H_5O_2)_2.H_2O$	301.47	
20	selenate	$BaSeO_4$	280.57	
21	silicate	$BaSiO_3$	213.43	rhombic
22	silicate	$BaSiO_3.6H_2O$	321.53	
23	succinate	$BaC_4H_4O_4$	253.40	
24	sulfate	$BaSO_4$	233.43	rhombic
25	sulfate, acid	$Ba(HSO_4)_2$	331.51	
26	sulfhydrate	$Ba(SH)_2.4H_2O$	275.58	rhombic
27	sulfide, mono-	BaS	169.43	rhombic yel.-grn.
28	sulfide, tetra-	$BaS_4.H_2O$	283.64	red, rhombic
29	sulfide, tri-	BaS_3	233.56	yel.-grn.
30	sulfite	$BaSO_3$	217.43	hex.
31	sulfocyanate	$Ba(CNS)_2.2H_2O$	289.55	needles
32	Beryllium (Glucinum)	Be, (Gl)	9.02	hex. gray
33	bromide	$BeBr_2$	168.85	need.
34	carbide	Be_2C	30.04	yel. hex.
35	carbonate	$BeCO_3.4H_2O$	141.08	
36	carbonate, basic	$(BeO)_5.CO_2.5H_2O$	259.18	
37	chloride	$BeCl_2$	79.93	need.
38	chloride	$BeCl_2.4H_2O$	152.00	cryst.
39	fluoride	BeF_2	47.02	
40	hydroxide	$Be(OH)_2$	43.04	white
41	iodide	BeI_2	262.88	need.
42	nitrate	$Be(NO_3)_2.3H_2O$	187.08	cryst.
43	oxide	BeO	25.02	hex.
44	oxychloride	Be_2OCl_2	104.95	
45	potassium fluoride	$BeF_2.2KF$	163.21	
46	sodium fluoride	$BeF_2.2NaF$	131.01	
47	sulfate	$BeSO_4.4H_2O$	177.15	tetrag.
48	sulfate	$BeSO_4.7H_2O$	231.20	

INORGANIC COMPOUNDS (Continued)

	Sp. Gr. $H_2O = 1$ (A) air = 1 (D) H_2 = 1	Melting-point, Deg. C.	Boiling-point, Deg. C.	Solubility in 100 parts of		
				Cold water	Hot water	Alcohol, acids, etc.
1	.....	.....	.....	$0.143^{0°}$	$0.326^{80°}$	
2	4.85	.....	.....	i.	.....	d. a.
3	4.298	.....	.....	dec.		
4	$3.244^{23°}$	575	d.	$5.2^{0°}$	$32.2^{100°}$	i. al; sl. s. a
5	$3.173^{29°}$	d. 115	.....	$58^{0°}$	$97^{35°}$	1.6 94% al.
6	2.6578	.....	.....	$0.0093^{18°}$	$0.0228^{100°}$	i. al.; s. a., NH_4Cl
7	4.73–5.46	BaO_2, 450	.....	$1.5^{0°}$	$90.8^{80°}$	s. HCl, HNO_3
8	5.32–.74					
9	.....	505	.....	v. s.	v. s.	v. s. al.
0	.....	.....	.....	$62.5^{11°}$	$72.4^{25°}$	
1	4.958	–O, 450	.....	i.	dec.	s. dil. a.
2	.....	.....	.....	i.	dec.	s. dil. a.
3	.....	.....	.....	$52.2^{0°}$	.....	s. al.
4	$4.165^{15°}$	.....	.....	0.01–.02	.....	s. a., NH_4 salts
5	$2.9^{4°}$	.....	.....	dec.	dec.	s. a.
6	$3.9^{20°}$	.....	.....	0.01	.....	s. a., NH^4 salts
7	$4.1^{16°}$	.....	.....	i.	.....	s. a.
8	3.054	.....	.....	$3^{16°}$		
9	.....	.....	.....	$47.98^{0°}$	$67.85^{80°}$	
0	4.75	.....	.....	0.0118	0.0138	i. HNO_3; s. HCl
1	$4.44^{19°}$	1470	.....	s.	dec.	s. HCl
2						
3	.....	.....	.....	$0.421^{0°}$	$0.237^{80°}$	sl. s. al.
4	4.25–.50	1580, d.	.....	$0.000173^{20°}$	$0.00031^{37.7°}$	0.006, 3% HCl; s. conc. H_2SO_4
5						
6	.....	.....	.....	s.	.....	i. al.
7	$4.25^{15°}$	.....	.....	dec.	dec.	i. al.
8	2.98	d. 300	.....	$41^{15°}$	v. s.	i. al., CS_2
9	.....	.....	.....	s.		
0	.....	.....	.....	$0.0197^{20°}$	$0.00177^{80°}$	v. s. HCl
1	.....	.....	.....	s.	s.	s. al.
2	$1.85^{20°}$	1280	>1900	i.	sl. s., d.	s. dil. a., alk.
3	.....	601	subl. 450	deliq.	v. s.	
4	$1.9^{15°}$	.....	.....	dec.	dec.	s. a.
5	.....	.....	.....	$0.36^{0°}$		
6	.....	.....	.....	i.	dec.	s. a., alk.
7	.....	400	500	deliq.	v. s.	v. s. al.
8	.....	.....	.....	deliq.	v. s.	s. al.
9	$2.1^{15°}$	800	.....	v. s.	v. s.	s. al., H_2SO_4
0	.....	d.	.....	i.	.....	s. a., alk., $(NH_4)_2CO_3$
1	4.20^{15}	510	585–95	dec.	dec.	s. al., eth., CS_2
2	.....	90	d. 100	deliq.	v. s.	v. s. al.
3	$3.016^{0°}$....	.....	.....	i.	.....	s. a., alk.
4	.....	.....	.....	i.		
5	.....	.....	.....	$2^{20°}$	$5.26^{100°}$	
6	.....	.....	.....	$1.47^{18°}$	$2.94^{100°}$	
7	$1.7125^{10.5°}$	$-2H_2O$,	100 d.	$100^{14°}$	v. s.	i. al.

PHYSICAL CONSTANTS OF

	Name	Formula	Mol. wt.	Crystalline form and color
1	Bismuth	Bi	209.00	rhbdr. pinkish
2	bromide	$BiBr_3$	448.75	yel. cryst.
3	carbonate, sub-	$Bi_2O_3.CO_3.H_2O$	544.02	
4	chloride, di-	$BiCl_2$	279.91	black need.
5	chloride, tri-	$BiCl_3$	315.37	wh. cryst.
6	citrate	$BiC_6H_5O_7$	398.04	cryst.
7	dichromate, basic	$(BiO)_2Cr_2O_7$	766.02	orange red
8	hydroxide	$Bi(OH)_3$	260.02	white
9	iodide	BiI_3	589.80	black hex.
10	iodate	$Bi(IO_3)_3$	733.80	white
11	nitrate	$Bi(NO_3)_3.5H_2O$	485.10	tricl.
12	nitrate, sub-	$BiONO_3.H_2O$	305.02	hex. pl.
13	oxalate	$Bi_2(C_2O_4)_3$	682.00	
14	oxide, tri-	Bi_2O_3	466.00	yel. tetrag.
15	oxide, tetra-	$Bi_2O_4.2H_2O$	518.03	brown-yel.
16	oxide, penta-	Bi_2O_5	498.00	brown
17	oxide, penta	$Bi_2O_5.H_2O$	516.02	red
18	oxybromide	BiOBr	304.92	
19	oxychloride	BiOCl	260.46	white
20	oxyfluoride	BiOF	244.00	cryst.
21	oxyiodide	BiOI	351.93	red cryst.
22	phosphate	$BiPO_4$	304.03	
23	selenide	Bi_2Se_3	655.60	black
24	sulfate	$Bi_2(SO_4)_3$	706.19	wh. need.
25	sulfide	Bi_2S_3	514.19	br. rhomb.
26	Boric acid	H_3BO_3	61.84	tricl. wh.
27	Boron	B	10.82	grn. amor., monocl.
28	bromide	BBr_3	250.57	
29	carbide	B_6C	76.92	black cryst.
30	chloride	BCl_3	117.19	
31	fluoride	BF_3	67.82	gas
32	iodide	BI_3	391.62	cryst. plates
33	hydride	BH_3	13.84	gas
34	oxide	B_2O_3	69.64	
35	phosphide	BP	41.85	
36	sulfide, tri-	B_2S_3	117.83	white cryst.
37	sulfide, penta-	B_2S_5	181.96	cryst.
38	Borofluohydric acid	HBF_4	87.83	
39	Bromic acid	$HBrO_3$	128.92	colorl.
40	Bromine	Br_2	159.83	red brown liq.
41	chloride	$BrCl.10H_2O$	295.53	yellow
42	fluoride	BrF_3	136.92	prisms
43	hydrate	$Br_2.10H_2O$	339.99	red octahdr.
44	iodide	BrI	206.85	

INORGANIC COMPOUNDS (Continued)

Sp. Gr. $H_2O = 1$ (A) air = 1 (D) H_2 = 1	Melting-point, Deg. C.	Boiling-point, Deg. C.	Solubility in 100 parts of		
			Cold water	Hot water	Alcohol, acids, etc.
9.78$^{20°}$	269.2	1436	i.	i.	s. HNO_3, aq. rg., conc. H_2SO_4
5.604	219	453	dec.	dec.	s. eth., HBr
6.86	d.	.....	i.	i.	s. a.
4.86	163	d. 300	dec.		
4.56$^{11°}$	232	447	dec.	dec.	s. al., a., acet.
.....	d.	.....	i.	.....	i. al.; s. NH_4OH
.....	.....	.....	i.	i.	s. a.; i. alk.
.....	$-H_2O$, 100	$-1\frac{1}{2}H_2O$, 150	i.	.....	s. a.; i. alk.
5.65$^{20°}$	408	.....	i.	dec.	35$^{20°}$ al.; s. HI, KI
.....	.....	.....	i.	.....	sl. s. HNO_3
2.78	74	d. 75–80	dec.	dec.	s. a.; 40$^{19°}$ acet.
4.928$^{15°}$	d. 260	.....	i.	i.	s. a.
.....	.....	.....	i.	i.	s. a.
8.868	820–60	.....	i.	i.	s. a.
5.6	$-O$, 305	.....	i.	.....	s. a.
.....	$-O$, 150	$-2O$, 357	i.	i.	s. a., KOH
5.917	$-H_2O$, 120	$-2O$, 357	i.	.....	s. a; KOH
8.082$^{15°}$	.....	.....	i.	.....	s. a.
7.717$^{15°}$	.....	.....	i.	i.	s. a.; i. $H_2C_4H_4O_6$
7.55$^{20°}$	.....	.....	i.	.....	s. a.
7.922$^{15°}$	.....	.....	i.	.....	s. a.; i. KI
.....	.....	.....	i.	i.	s. HCl; i. dil. HNO_3
6.82	d.	.....	i.	.....	i. alk.
.....	.....	.....	dec.	dec.	s. a.
7.39	d.	.....	0.000018	.....	s. HNO_3
1.4347$^{15°}$	185	$-1\frac{1}{2}H_2O$, 300	4.9$^{21°}$	28.7$^{100°}$	0.24$^{25°}$ eth.; s. al.; 28$^{20°}$, 72$^{100°}$ glyc.
2.45–.55	2000–2500	subl. 3500	i.	i.	i. al.; s. HNO_3, H_2SO_4
2.65$\frac{2}{4}°$	−46	90.5	dec.	.....	d. al.
2.51	.....	.....	i.	i.	i. a.
1.434$\frac{2}{4}°$	−107	18.23	dec.	dec.	d. al.
2.3 (A)	−127	−101	105.7$^{0°}$ c.c.	.....	d. al.
3.3$^{50°}$	43	210	dec.	.....	v. s. CS_2, CCl_4
.....	−140	−87	sl. s.	dec.	s. NH_4OH
1.75–.83	577	.....	1.1$^{0°}$	16.4$^{102°}$	s. al., a.
.....	ign. 200	.....	i.	i.	i. all solv.
1.55	310	.....	dec.	.....	sl. s. PCl_3, SCl_2
1.85	390	.....	dec.		
.....	.....	130	s.		
.....	d. 100	.....	v. s.	dec.	
3.1883$^{0°}$	−7.3	58.7	4.17$^{0°}$	3.49$^{50°}$	s. alk., CS_2, eth., al.
.....	7	d. 10	s.	.....	s. CS_2, eth.
.....	5	130–40	dec.	.....	d. alk.
.....	d. 15	.....	s.		
.....	36	.....	.....	.....	s. CS_2, $CHCl_3$

	Name	Formula	Mol. wt.	Crystalline form and color
1	Bromplatinic *see platinic*			
2	Cadmium	Cd	112.41	hex.
3	acetate	$Cd(C_2H_3O_2)_2.3H_2O$	284.51	monocl. colorl.
4	borotungstate	$Cd_2B_2W_9O_{32}.18H_2O$	2738.75	yel. cryst.
5	bromate	$Cd(BrO_3)_2.H_2O$	386.26	tricl.
6	bromide	$CdBr_2$	272.24	yel'sh. cryst.
7	carbonate	$CdCO_3$	172.41	
8	chlorate	$Cd(ClO_3)_2.2H_2O$	315.36	
9	chloride	$CdCl_2$	183.32	hex.
10	chloride	$CdCl_2.2H_2O$	219.36	monocl.
11	cyanide	$Cd(CN)_2$	164.43	
12	ferrocyanide	$Cd_2Fe(CN)_6$	436.71	
13	fluoride	CdF_2	150.41	cryst.
14	formate	$Cd(CHO_2)_2.H_2O$	220.44	monocl.
15	hydroxide	$Cd(OH)_2$	146.43	hex. wh.
16	iodate	$Cd(IO_3)_2$	462.27	cryst.
17	iodide	CdI_2	366.27	brownish
18	lactate	$Cd(C_3H_5O_3)_2$	290.49	need.
19	nitrate	$Cd(NO_3)_2.4H_2O$	308.49	prism. need.
20	oxalate	$CdC_2O_4.3H_2O$	254.46	
21	oxide	CdO	128.41	brown amor.
22	oxide	CdO	128.41	reg.
23	oxide, sub-	Cd_4O	465.64	grn. amor.
24	permanganate	$Cd(MnO_4)_2.6H_2O$	458.40	
25	phosphate	$Cd_3(PO_4)_2$	527.28	amor.
26	potassium iodide	$CdI_2.2KI.2H_2O$	734.36	
27	selenate	$CdSeO_4.2H_2O$	291.64	rhombic
28	sulfate	$CdSO_4$	208.47	
29	sulfate	$CdSO_4.4H_2O$	280.54	
30	sulfate	$3CdSO_4.8H_2O$	769.55	monocl. or amor.
31	sulfide (Greenockite)	CdS	144.47	yel. hex.
32	sulfite	$CdSO_3$	192.47	cryst.
33	tungstate	$CdWO_4$	360.41	yel. cryst.
34	Caesium	Cs	132.81	silvery yel.
35	bromide	$CsBr$	212.73	
36	bromoiodide	$CsBrI_2$	466.59	
37	carbonate	Cs_2CO_3	325.62	
38	carbonate, acid	$CsHCO_3$	193.82	rhomb. prisms
39	chloraurate	$CsAuCl_4$	471.84	
40	chloride	$CsCl$	168.27	reg. colorl.
41	chloroplatinate	Cs_2PtCl_6	673.59	yel. reg.
42	chromate	$CsCrO_4$	248.82	
43	cyanide	$CsCN$	158.82	
44	fluosilicate	Cs_2SiF_6	407.68	reg.
45	hydride	CsH	133.82	cryst.
46	hydroxide	$CsOH$	149.82	gray

INORGANIC COMPOUNDS (Continued)

Sp. Gr. $H_2O = 1$ (A) air = 1 (D) H_2 = 1	Melting-point, Deg. C.	Boiling-point, Deg. C.	Solubility in 100 parts of		
			Cold water	Hot water	Alcohol, acids, etc.
$8.65^{20°}$	320.9	778	i.	i.	s. a., NH_4NO_3
2.01	.....	.....	v. s.		
.....	.....	.....	$1250^{19°}$		
3.758	d.	.....	$125^{17°}$		
$5.192^{25°}_{4°}$	568	806–12	61.1	$161^{100°}$	$26.6^{15°}$ al.; $0.4^{15°}$ eth.
$4.258^{4°}$	d.	.....	i.	i.	s. a., NH_4 salts
.....	80	.....	$339^{0°}$	$549^{65°}$	s. a.
$4.052^{20°}$	568	861–954	$140^{20°}$	$150^{100°}$	$1.52^{15°}$ al.
3.32	.....	.....	$168^{20°}$	$180^{100°}$	$2.05^{15°}$ meth. al.
.....	d. 200	.....	$1.7^{15°}$	.....	s. KCN, NH_4OH, a.
.....	.....	.....	i.	.....	s. HCl
6.64	520	1000	$4.36^{15°}$	.....	i. al.; s. a.
2.45	d.	.....	v. s.		
$4.79^{15°}$	$-H_2O$, 300	.....	$0.00026^{25°}$	.....	i. alk.; s. a., NH_4 salts
5.64–.98	d.	.....	sl. s.	sl. s.	s. HNO_3, NH_4OH
5.644	385 (404)	708–19	$80.1^{0°}$	$128^{100°}$	s. a., eth., NH_4OH
.....	.....	.....	10	12.5	i. al.
2.455	59.5	132	$103.4^{0°}$	.....	s. al.; i. HNO_3
Anh. $3.32^{18°}$	d.	.....	$0.00337^{18°}$	0.009	s. a., NH_4OH
6.95	.....	d. 900–1000	i.	i.	s.a., NH_4salts; i. alk.
8.11	.....	.....	i.	i.	
8.18–.21$^{19°}$	d.	.....	.....	.....	d. alk., a.
.....	d.	.....	v. s.		
.....	.....	.....	i.	.....	s. a., NH_4salts
3.359	.....	.....	$137^{15°}$	.....	$71^{15°}$ al.; $42^{15°}$ eth.
3.632	.....	.....	v. s.		
$4.72^{15°}$	1000	.....	$76.5^{0°}$	$60.8^{100°}$	
3.05	.....	.....	$140^{0°}$	$135.5^{100°}$	i. al.
$3.087^{25°}_{4°}$	.....	.....	$114.2^{0°}$	$87^{100°}$	
4.8	.....	.....	0.00013	colloidal	v. s. NH_4OH; s. a.
.....	d.	.....	sl. s.	.....	i. al.; s. a., NH_4OH
.....	.....	.....	0.05	.....	s. NH_4OH
$1.87^{20°}$	26.4	670	dec.	dec.	s. a., al.
$4.455^{21°}$	.....	.....	s.	.....	d. al.
.....	.....	.....	dec.	.....	s. al.
.....	.....	d. 610	$382.3^{20°}$	v. s.	$11.1^{19°}$, $20.1^{79°}$ al.
.....	$-\frac{1}{2}CO_2$, 175	.....	210.2	v. s.	s. al.
.....	.....	.....	$0.5^{10°}$	$38^{100°}$	s. al.
$3.972^{20°}_{4°}$	646	subl.	$161.4^{0°}$	$270.5^{100°}$	s. al.
.....	.....	.....	$0.024^{0°}$	$0.377^{100°}$	
4.237	.....	.....	$71.35^{13°}$	$88.66^{30°}$	
.....	.....	.....	.....	.....	i. al.
$3.376^{17°}_{17°}$	.....	.....	$60^{17°}$	v. s.	i. al.
2.7	d.	.....	dec.	dec.	d. a.
4.018	<272.3	.....	$301.3^{30°}$	s.	s. al.

	Name	Formula	Mol. wt.	Crystalline form and color
1	Caesium iodide	CsI	259.74	
2	mercuric bromide	$CsBr.2HgBr_2$	933.61	
3	mercuric chloride	$CsCl.HgCl_2$	439.79	
4	nitrate	$CsNO_3$	194.82	tetrag.
5	nitrite	$CsNO_2$	178.82	yel. cryst.
6	oxide, mono-	Cs_2O	281.62	or. cryst.
7	oxide, di-	Cs_2O_2	297.62	yel. need.
8	oxide, tri-	Cs_2O_3	313.62	choc. br.
9	oxide, tetra- (per)	Cs_2O_4	329.62	yel. cryst.
10	perchlorate	$CsClO_4$	232.27	
11	periodate	$CsIO_4$	323.74	rhombic pl.
12	permanganate	$CsMnO_4$	251.74	
13	silicotungstate	$Cs_8SiW_{12}O_{42}$	3970.54	
14	sulfate	Cs_2SO_4	361.68	need.
15	sulfide	$Cs_2S.4H_2O$	369.75	cryst.
16	sulfide, di-	Cs_2S_2	329.75	dk. red, amor.
17	sulfide, di-	$Cs_2S_2.H_2O$	347.76	cryst.
18	sulfide, tri-	Cs_2S_3	361.81	orange
19	sulfide, penta-	Cs_2S_5	425.94	
20	tartrate acid	$CsHC_4H_4O_6$	281.85	
21	Calcium	Ca	40.07	silv. hex. or rhbdr.
22	acetate	$Ca(C_2H_3O_2)_2.H_2O$	176.13	need.
23	aluminate	$CaAl_2O_4$	158.01	prism. need.
24	ammonium arsenate	$NH_4CaAsO_4.6H_2O$	305.17	monocl. pl.
25	ammonium phosphate	$NH_4CaPO_4.7H_2O$	279.25	monocl.
26	arsenate	$Ca_3(AsO_4)_2$	398.13	
27	arsenide	Ca_3As_2	270.13	red cryst.
28	borate	$Ca(BO_2)_2.2H_2O$	161.74	
29	boride	CaB_6	104.99	black reg.
30	bromide	$CaBr_2$	199.90	need.
31	bromide	$CaBr_2.6H_2O$	308.00	cryst.
32	carbide	CaC_2	64.07	cryst. gray
33	carbonate	$CaCO_3$	100.07	hex. rhomb. or rhbdr
34	chlorate	$Ca(ClO_3)_2$	206.98	rhomb.
35	chloride	$CaCl_2$	110.98	
36	chloride	$CaCl_2.H_2O$	129.00	
37	chloride	$CaCl_2.6H_2O$	219.08	hex.
38	chromate	$CaCrO_4.2H_2O$	192.11	yel. prisms
39	citrate	$Ca_3(C_6H_5O_7)_2.4H_2O$	570.35	need.
40	cyanide	$Ca(CN)_2$	92.09	reg.
41	cyanamide	$CaCN_2$	66.08	
42	ferrocyanide	$Ca_2Fe(CN)_6.12H_2O$	508.22	tricl.
43	fluoride	CaF_2	78.07	reg.
44	fluosilicate	$CaSiF_6$	182.13	
45	formate	$Ca(CHO_2)_2$	130.09	rhombic
46	hydride	CaH_2	42.09	cryst.
47	hydroxide	$Ca(OH)_2$	74.09	hex.
48	hypochlorite	$Ca(ClO_2)_2.4H_2O$	247.05	
49	hypophosphate	$Ca_2P_2O_6.2H_2O$	274.23	
50	hypophosphite	$Ca(H_2PO_2)_2$	170.16	monocl.
51	iodate	$Ca(IO_3)_2$	389.93	rhombic

INORGANIC COMPOUNDS (Continued)

Sp. Gr. $H_2O = 1$ (A) air = 1 (D) H_2 = 1	Melting-point, Deg. C.	Boiling-point, Deg. C.	Solubility in 100 parts of		
			Cold water	Hot water	Alcohol, acids, etc.
4.51^{24°	621	.....	27.7^{0°	$51.5^{35.6^\circ}$	
.....	.....	.....	0.807^{16°	.....	sl. s. al.
.....	.....	.....	1.406^{17°	.....	i. al.
$3.687^{28^\circ}_{4^\circ}$	414	d.	9.33^{0°	197^{100°	sl. s. al.
.....	.....	.....	v. s.	v. s.	
4.78^{0°	C_2O_4, 150	.....	v. s.	.....	s. abs. al.
4.47^{15°	400–50	–O, 650	s.		
4.25^{0°	400	.....	dec.		
3.77^{19°	515	d.	dec.		
.....	d.	.....	i.	.....	i. abs. al.
4.259^{15°	.....	.....	2.15^{15°		
$3.5974^{10.3^\circ}$	d.	.....	0.097^{1°	1.25^{59°	
.....	.....	.....	0.005^{20°	0.52^{100°	i. al., HCl
$4.2434^{20^\circ}_{4^\circ}$	.....	.....	167^{0°	220.3^{100°	i. al.
.....	.....	.....	v. s.	v. s.	
.....	460	>800	hyg.		
.....	.....	.....	s.		
.....	217	>800			
2.806^{10°	202.5	.....	.....	.....	s. al.
.....	.....	.....	9.7^{25°	98^{100°	
1.5446^{29°	810	.....	dec.	dec.	sl. s. al.; s. a.
.....	d.	.....	43.6^{0°	34.3^{100°	sl. s. al.
3.871^{20°	1587	.....	dec.	.....	s. HCl
1.905^{15°	d.	.....	0.02	s.	i. NH_4OH; s. NH_4Cl
1.561	d.	.....	i.	i.	s. a.
.....	.....	.....	i.	i.	
2.5^{15°	d.	.....	dec.	dec.	s. a.
.....	.....	.....	0.40^{30°	0.40^{90°	s. a., NH_4 salts
2.33^{15°	.....	.....	i.	i.	s. HNO_3
$3.353^{25^\circ}_{4^\circ}$	680–760	806–12	125^{0°	312^{105°	v. s. al.
.....	35–8	149–50	50^{0°		
2.22^{18°	.....	.....	dec. to C_2H_2		
2.70–.95	d. 825	.....	0.0065^{20°	0.002^{100°	s. a., NH_4Cl
.....	>100	.....	177.7^{8°	.....	s. al.
$2.152^{20^\circ}_{4^\circ}$	774	.....	59.5^{0°, 74.5^{20°.	159^{100°	s. al.
.....	.....	.....	69.1^{0°	205^{80°	s. al.
1.654	30.2	129–30	165.7^{0°	7141^{40°	s. al.
.....	$-2H_2O$, 200	.....	22.2^{0°	4.3^{100°	s. al., a.
.....	$-2H_2O$, 130	$-4H_2O$, 185	0.085^{18°	0.096^{25°	0.0065^{18° al
.....	.....	.....	s.	s.	
.....	.....	.....	.....	s. dec.	
.....	.....	.....	.....	50^{90°	
3.18	1378	.....	$0.0037^{15.5^\circ}$	0.0016^{18°	sl. s. a.
$2.66^{217.5^\circ}$	.....	.....	sl. s.	.....	s. HF, HCl
2.021	d.	.....	16^{0°	18.4^{100°	i. al.
1.7	.....	.....	dec.	dec.	d. a.; i. bz.
2.078	$-H_2O$, 580	.....	0.17^{0°	0.08^{100°	s. NH_4Cl
.....	d.	.....	deliq.	dec.	d. a.
.....	.....	.....	i.	.....	s. $H_4P_2O_6$, HCl
.....	d.	.....	17	s.	i. al.
.....	d.	.....	0.4^{15°	1.33^{100°	s. HNO_3

	Name	Formula	Mol. wt.	Crystalline form and color
1	Calcium iodide	CaI_2	293.93	plates
2	iodide	$CaI_2.6H_2O$	402.03	
3	lactate	$Ca(C_3H_5O_3)_2.5H_2O$	308.23	
4	nitrate	$Ca(NO_3)_2$	164.09	prisms
5	nitrate	$Ca(NO_3)_2.4H_2O$	236.15	monocl.
6	nitride	Ca_3N_2	148.23	br. cryst.
7	nitrite	$Ca(NO_2)_2.H_2O$	150.10	prisms
8	oxalate	$CaC_2O_4.H_2O$	146.09	colorl. octah.
9	oxide	CaO	56.07	amor. or reg.
10	permanganate	$Ca(MnO_4)_2.4H_2O$	349.99	purp. prisms
11	peroxide	$CaO_2.8H_2O$	216.20	tetrag.
12	phosphate, mono-	$CaH_4(PO_4)_2.H_2O$	252.17	rhombic
13	phosphate, di-	$CaHPO_4.2H_2O$	172.14	monocl. plates
14	phosphate, tri-	$Ca_3(PO_4)_2$	310.26	amor.
15	phosphate, pyro-	$Ca_2P_2O_7.4H_2O$	326.26	cryst.
16	phosphate, meta-	$Ca(PO_3)_2$	198.12	white
17	phosphide	Ca_3P_2	182.26	red cryst.
18	phosphite	$2CaHPO_3.3H_2O$	294.26	
19	plumbate	Ca_2PbO_4	351.34	brown cryst.
20	plumbite	$CaPbO_2$	279.27	cryst.
21	potassium sulfate	$CaK_2(SO_4)_2.H_2O$	328.41	monocl.
22	phosphate, pyro-	$Ca_2P_2O_7$	254.19	white
23	salicylate	$Ca(C_7H_5O_3)_2.2H_2O$	350.18	octahdr.
24	silicate	$CaSiO_3$	116.13	monocl. or hex.
25	silicide	$CaSi_2$	96.19	
26	sodium sulfate	$CaSO_4.2Na_2SO_4.2H_2O$	456.28	
27	sulfate	$CaSO_4$	136.13	rhombic
28	sulfate (gypsum)	$CaSO_4.2H_2O$	172.17	monocl.
29	sulfhydrate	$Ca(SH)_2.6H_2O$	214.31	prismatic
30	sulfide	CaS	72.13	reg. wh.
31	sulfite	$CaSO_3.2H_2O$	156.17	cryst.
32	sulfocyanate	$Ca(CNS)_2.3H_2O$	210.26	cryst.
33	tartrate	$CaC_4H_4O_6.4H_2O$	260.17	trimet. prisms
34	thiocarbonate	$CaCS_3$	148.26	yellow
35	thiosulfate	$CaS_2O_3.6H_2O$	260.29	tricl.
36	tungstate	$CaWO_4$	288.07	tetrag.
37	Carbon, amorphous	C	12.00	amor., blk.
38	Carbon, graphite	C	12.00	hex. blk.
39	Carbon, diamond	C	12.00	reg.
40	bromide, di-	C_2Br_4	343.66	
41	bromide, tri-	C_2Br_6	503.50	
42	bromide, tetra-	CBr_4	331.66	tablets
43	chloride, di-	C_2Cl_4	165.83	
44	chloride, tri-	C_2Cl_6	236.74	rhomb. tricl. or reg.
45	chloride, tetra-	CCl_4	153.83	colorl. liq.
46	dioxide	CO_2	44.00	colorl. gas

INORGANIC COMPOUNDS (Continued)

Sp. Gr. $H_2O = 1$ (A) air = 1 (D) $H_2 = 1$	Melting-point, Deg. C.	Boiling-point, Deg. C.	Solubility in 100 parts of		
			Cold water	Hot water	Alconol, acids, etc.
$3.956^{3.8°}_{4}$	631	708–19	$192^{0°}$	$435^{92°}$	s. a., al.
.....	42	160	$907^{0°}$	v. s.	
.....	$-3H_2O$, 100	.....	10.5	.....	i. eth.; s. al.
2.36	561	.....	$93.1^{0°}$	$351.2^{152°}$	$14^{15°}$ al.; s. amyl al.
$1.9^{16°}$	42.3	132	$134^{0°}$	$506^{152°}$	s. al.
$2.63^{17°}$	1200	.....	dec.	dec.	s. dil. a.; i. abs. al.
$2.231^{34°}$	.....	.....	deliq.	v. s.	i. al.
$2.2^{4°}$ anh.	d.	.....	$0.0006^{13°}$	$0.0014^{95°}$	s. a.; i. acet. a.
$3.306^{5°}$	2570	.....	$0.131^{0°}$	$0.067^{80°}$	s. a.
.....	d.	.....	$331^{14°}$	$388^{25°}$	
.....	$-8H_2O$, 130	.....	sl. s.	dec.	s. a.
$2.220^{3.8°}_{4}$	$-H_2O$, 100	d. 200	.....	dec.	
$2.306^{3.8°}_{4}$	d.	.....	$0.02^{24.5°}$	$0.075^{100°}$	
3.18	1550	.....	0.0023–31	dec.	s. a.
.....	.....	.....	sl. s.	.....	s. a.; i NH_4Cl
.....	.....	.....	i.	i.	i. a.
$2.51^{15°}$	.....	.....	dec.	.....	i. al., eth.; s. dil. a.
.....	.....	.....	sl. s.	dec.	s. NH_4Cl
.....	.....	.....	i.	.....	s. a.
.....	.....	.....	sl. s.		
$2.6^{17°}$	.....	.....	0.25	dec.	s. a.
.....	.....	.....	i.	.....	s. a.
.....	.....	.....	v. s.	.....	s. al.
$2.919^{18°}$	1512	.....	$0.0095^{17°}$	.....	s. HCl
2.5	.....	.....	i.		
.....	$-2H_2O$, 80	.....	.....	dec.	
2.96	1360	.....	$0.179^{0°}$	$0.178^{100°}$	s. a., $Na_2S_2O_3$, NH_4 salts, HCl, NaCl, glyc.
2.32	$-2H_2O$, 300	.....	$0.241^{0°}$	$0.222^{100°}$	
.....	d. 15–18	.....	v. s.	.....	s. al.
$2.8^{15°}$	.....	.....	dec.	dec.	s. a.
.....	$-2H_2O$, 100	.....	0.125	.....	s. H_2SO_3
.....	.....	.....	deliq.	v. s.	v. s. al.
.....	d.	.....	$0.016^{15°}$	$0.3^{100°}$	sl. s. al.
.....	.....	.....	s.	.....	s. al.
1.872	.....	.....	$0.3^{10°}$	dec.	i.
6.062	.....	.....	0.2	.....	i. a.; s. NH_4Cl
1.75–2.10	>3500	subl. 3500	i.	i.	i. a., alk.
2.3	.....				
3.51	.....				
.....	53				
.....	.....	.....	.....	.....	s. CS_2; i. al., eth.
$3.42^{14°}$	92	189.5	i.	.....	s. al, eth., chl.
$1.62^{20°}$	.....	121			
1.6298 (A) 8.15 (D)	182	187	i.	.....	s. al., eth.
$1.5817^{1°}_{4}$	−23.77	76.74	i.	i.	s. al.
1.53 (A) 22.(D)	−57	subl. −80	179.67° c.c.	90.14°° c.c.	s. a., alk.

PHYSICAL CONSTANTS OF

	Name	Formula	Mol. wt.	Crystalline form and color
1	Carbon disulfide	CS_2	76.13	colorl. liq.
2	iodide, tetra	CI_4	519.73	octahdr.
3	monoxide	CO	28.00	colorl. odorless, poisonous gas
4	monosulfide	CS	44.06	red powd.
5	oxybromide	$COBr_2$	187.83	
6	oxychloride (phosgene)	$COCl_2$	98.91	gas, poisonous
7	oxysulfide	COS	60.06	gas
8	selenosulfide	$CSSe$	123.26	liq.
9	silicide	CSi_2	68.12	gr. cryst.
10	suboxide	C_3O_2	68.00	gas
11	telluro-sulfide	$CSTe$	171.56	yel.-red
12	thionyl chloride	$CSCl_2$	114.98	golden red
13	thionyl perchloride	$CSCl_4$	185.89	golden yel.
14	Ceric carbide	CeC_2	164.25	red hex.
15	fluoride	$CeF_4.H_2O$	234.27	amor.
16	hydroxide	$2CeO_2.3H_2O$	398.55	
17	nitrate	$Ce(NO_3)_4$	388.28	red-yel.
18	oxide	CeO_2	172.25	pale yel. powd.
19	peroxide	CeO_3	188.25	red
20	silicide	$CeSi_2$	196.37	
21	sulfate	$Ce(SO_4)_2.4H_2O$	404.44	yel. need.
22	Cerium	Ce	140.25	steel gray
23	Cerous acetate	$Ce_2(C_2H_3O_2)_6.3H_2O$	688.69	need.
24	bromide	$CeBr_3.H_2O$	398.01	need.
25	carbonate	$Ce_2(CO_3)_3.5H_2O$	550.58	wh. powd.
26	chloride	$CeCl_3$	246.62	cryst.
27	fluoride	$CeF_3.\frac{1}{2}H_2O$	206.26	
28	hydroxide	$Ce_2O_3.6H_2O$	436.60	
29	iodide	$CeI_3.9H_2O$	683.19	cryst.
30	nitrate	$Ce(NO_3)_3.6H_2O$	434.37	red. cryst.
31	oxalate	$Ce_2(C_2O_4)_3.9H_2O$	706.64	
32	oxide	Ce_2O_3	328.50	gr. powd.
33	oxychloride	$Ce_2O_3.2CeCl_3$	821.74	purple
34	phosphate	$CePO_4$	235.28	monocl. pr. or rhombic
35	sulfate	$Ce_2(SO_4)_3$	568.69	monocl. or rhombic
36	sulfate	$Ce_2(SO_4)_3.8H_2O$	712.82	monocl., tricl.
37	sulfide	Ce_2S_3	376.69	red cryst.
38	Chloric acid	$HClO_3.7H_2O$	210.58	
39	Chlorine	Cl_2	70.91	greenish yel. gas
40	hydrate	$Cl.5H_2O$	125.54	octahdr.
41	oxide, mono	Cl_2O	86.91	yel. red

ORGANIC COMPOUNDS (Continued)

Sp. Gr. $H_2O = 1$ (A) air = 1 (D) H_2 = 1	Melting-point, Deg. C.	Boiling-point, Deg. C.	Solubility in 100 parts of		
			Cold water	Hot water	Alcohol, acids, etc.
1.2923° (A) 2.63 (A)	−110	46.2	0.2°°	0.014⁵⁰°	s. al., eth.
4.32²⁰°	d.	.....	.....	dec.	s. al., CS_2, eth.
0.9670 (A)	−205.7	−192	3.5°° c.c.	0.0018⁵⁰°	s. al., Cu_2Cl_2
			0.0044°°	2.312²⁰° c.c.	
1.66	d.	.....	i.	.....	i. al.; s. CS_2, eth.
2.48°°	.....	63–6			
1.432°°	.....	8.2	dec.	.....	s. acet. a.; d. a.
2.10 (A)	d.	−47	133°°	40.3³⁰°	v. s. al., alk.
30.4 (D)					
.....	−85	84	i.	i.	s. CS_2; sl. s. al.
2.5	.....	.....	dec.	dec.	i. al., eth.; s. HNO_3, H_2SO_4
.....	−107	−7	dec.		
.....	−54	d.	.....	.....	s. CS_2, bz.
1.5085¹⁵°	.....	170			
1.712¹³°	.....	146–7	.....	dec.	
5.23	.....	.....	dec.	dec.	s. a.
.....	d.	.....	i.		
.....	.....	.....	.....	.....	s. a.; i. alk; sl. s. alk. carb.
.....	.....	.....	deliq.	dec.	s. al.
7.65	.....	.....	i.	i.	s. H_2SO_4
5.67¹⁷°	.....	.....	i.		
.....	.....	.....	s.		
6.92²⁵°	640	.....	i.	i.	i. al., HNO_3, HCl
.....	$-3H_2O$, 115	d.	26.45¹⁵°	16.2⁷⁸°	
.....	d.	.....	deliq.	.....	s. al.
.....	.....	.....	i.	.....	s. $(NH_4)_2CO_3$
3.88$\frac{4}{14}$°	848	.....	100	dec.	30 al.
.....	.....	.....	i.		
.....	.....	.....	.....	.....	s. a., $(NH_4)_2CO_3$, i. alk.
.....	.....	.....	s.	.....	s. al.
.....	$-3H_2O$, 150	d. 200	deliq.	v. s.	50 al.
.....	d.	.....	0.053²⁵°	.....	i. $H_2C_2O_4$
6.9–7.0	.....	.....	i.	.....	s. H_2SO_4
.....	.....	.....	i.	.....	s. dil. a.
3.8	.....	.....	i.	i.	s. a.
.912	.....	.....	16.56°°	2.25¹⁰⁰°	
3.220	$-8H_2O$, 630	.....	23.8°°	6⁵⁰°	
5.020¹¹⁰°	d.	.....	i.	dec.	s. dil. a.
1.282¹⁴°	<−20	d. 40	v. s.		
2.49°° (A)	−101.5	−33.6	150°° c.c. 300¹⁰°° c.c.	180³⁰° 136⁴⁰°	s. alk.
1.23	−50	d. 35	s.		
2.977 (A)	−20	−5	200°° c.c.	.....	s. alk., H_2SO_4

PHYSICAL CONSTANTS OF

	Name	Formula	Mol. wt.	Crystalline form and color
1	Chlorine oxide, di- or per-	ClO_2	67.46	yellowish gas
2	oxide, hept-	Cl_2O_7	182.91	oil, colorl
3	oxide, tetr-	ClO_4	99.46	
4	Chlorosulfonic acid	$ClSO_2.OH$	116.53	
5	Chromic arsenide	CrAs	126.97	gray
6	boride	CrB	62.83	silvery cryst
7	bromide	$CrBr_3$	291.76	olive grn. hex
8	bromide	$CrBr_3.6H_2O$	399.85	green hex. pl
9	carbide	Cr_3C_2	180.06	gray cryst
10	chloride	$CrCl_3$	158.38	pink cryst
11	chloride	$CrCl_3.6H_2O$	266.48	violet or grn. hex. pl
12	fluoride	CrF_3	109.01	grn. octahdr
13	fluoride	$CrF_3.9H_2O$	271.15	
14	hydroxide	$Cr(OH)_3$	103.03	grn. or blue gel
15	hydroxide	$Cr(OH)_3.2H_2O$	139.07	green
16	nitrate	$Cr(NO_3)_3.9H_2O$	400.18	purp. prisms
17	nitrate	$Cr_2(NO_3)_6.15H_2O$	746.31	purp. monocl. pr
18	nitride	CrN	66.02	amor
19	oxide	Cr_2O_3	152.02	hex. dk. grn
20	phosphate	$Cr_2(PO_4)_2.6H_2O$	402.17	bl. grn
21	phosphate	$Cr_2(PO_4)_2.12H_2O$	510.27	violet, tricl
22	phosphide	CrP	83.04	gr.-blk. cryst
23	silicide	Cr_2Si_2	212.15	tetrag. pr
24	sulfate	$Cr_2(SO_4)_3$	392.21	
25	sulfate	$Cr_2(SO_4)_3.5H_2O$	482.29	green
26	sulfate	$Cr_2(SO_4)_3.15H_2O$	662.45	violet cryst
27	sulfate	$Cr_2(SO_4)_3.18H_2O$	716.50	reg. violet
28	sulfide	Cr_2S_3	200.21	br.-blk. powd
29	Chromium	Cr	52.01	gray cryst
30	dioxide	CrO_2	88.01	gray
31	tetrasulfide	Cr_3S_4	232.28	gr.-blk. powd
32	trioxide	CrO_3	100.01	red, tricl
33	Chromous acetate	$Cr_2(C_2H_3O_2)_6.2H_2O$	494.20	green
34	carbonate	$CrCO_3$	112.01	amor
35	chloride	$CrCl_2$	122.92	cryst
36	fluoride	CrF_2	90.01	grn. cryst
37	hydroxide	$Cr(OH)_2$	86.03	yel. brn
38	iodide	CrI_2	305.87	
39	oxide	CrO	68.01	black
40	sulfate	$CrSO_4.7H_2O$	274.19	blue
41	sulfide	CrS	84.07	black powd
42	Chromyl chloride	CrO_2Cl_2	154.92	dk. red liq
43	Cobalt	Co	58.94	silvery
44	carbonyl	$Co(CO)_4$	170.94	
45	phospnide	Co_2P	148.91	sm. need

INORGANIC COMPOUNDS (Continued)

Sp. Gr. $H_2O = 1$ (A) air = 1 (D) H_2 = 1	Melting-point, Deg. C.	Boiling-point, Deg. C.	Solubility in 100 parts of		
			Cold water	Hot water	Alcohol, acids, etc.
1.5	−79	9.9	2000[4°] c.c.	dec.	s. H_2SO_4, alk.
2.315 (A)					
.....	expl.	.....	s.	.....	s. bz.
1.784[0°/4°]	82	155.3	dec.	.....	i. CS_2; d. al.
6.35[15.6°]	.....	.....	i.	i.	i. a.
.....	.....	.....	i.		
.....	.....	.....	200	.....	v. s. al.
5.4[17°]	.....	.....	i.	i.	s. fused Na_2O_2
5.62	.....	.....	i.	i.	s. dil. HCl
2.757[15°]	.....	1200–1500	i.	sl. s.	i. a.
.....	subl. 83	.....	v. s.	.....	s. al.
3.78	d.	.....	i.	.....	i. al.; sl. s. a.
.....	.....	.....	v. s.	.....	i. al.; s. a.
.....	.....	.....	i.	.....	s. a., alk.; sl. s. NH_4OH
.....	.....	.....	i.	i.	s. a., alk.
.....	36.5	125.5	s.	s.	s. a., alk.
.....	100	.....	s.	s.	
.....	d. 1500	.....	i.	.....	i. a., alk.
5.04	1990	.....	i.	i.	sl. s. a.
.....	.....	.....	sl. s.	.....	s. a., alk.; i. acet. a.
2.121	$-7H_2O$, 100	.....	sl. s.	.....	s. a., alk.; i. acet. a.
5.71[15°]	.....	.....	i.	.....	i. a.; s. HNO_3, HF
5.6	.....	.....	i.	i.	s. HCl, HF; iHNO_3, H_2SO_4
3.012	.....	.....	s.	.....	i. a.
.....	.....	.....	.....	.....	v. s. al.
1.867[17°]	100	$-10H_2O$, 100	.....	d. 67°	i. al.
1.72[2°]	$-12H_2O$, 100	.....	120[20°]		
3.77[19°]	.....	.....	i.	dec.	s. HNO_3
6.92[20°]	1615	2200	i.	i.	s. HCl, dil.; H_2SO_4; i. HNO_3
.....	190	$-O$, 300	i.		
.....	.....	.....	i.	.....	sl. s. a.
2.74	196	d.	163.4[0°]	206.7[100°]	s. al., eth., H_2SO_4
.....	.....	.....	s.	.....	i. al.
.....	.....	.....	i.	.....	i. eth.
2.751[14°]	.....	.....	v. s.	v. s.	
4.11	1100	.....	sl. s.	.....	i. al.; s. h. HCl
.....	.....	.....	dec.	.....	s. a.
.....	.....	.....	v. s.		
.....	.....	.....	i.	i.	i. dil. HNO_3
.....	.....	.....	12.35[0°]	.....	sl. s. al.
4.08	.....	.....	i.	.....	v. s. a.
1.9591[0°]	−96.5	116.7	dec.		
8.72[21°]	1480	.....	i.	i.	s. a.
1.827[18°]	42–6	d. 135	i.	i.	s. CS_2, eth., al.
6.4[15°]	.....	.....	i.	i.	s. HNO_3

	Name	Formula	Mol. wt.	Crystalline form and color
1	Cobaltic boride	CoB	69.76	prisms
2	chloride	$CoCl_3$	165.31	
3	chloride dichro	$Co(NH_3)_3Cl_3.H_2O$	234.42	
4	chloride praseo	$Co(NH_3)_4Cl_3.H_2O$	251.46	green cryst.
5	chloride purpureo	$Co(NH_3)_5Cl_3$	250.47	
6	chloride luteo	$Co(NH_3)_6Cl_3$	267.50	
7	chloride roseo	$Co(NH_3)_5Cl_3.H_2O$	268.49	brick red
8	chromate	$2CoO.CrO_3.2H_2O$	285.92	
9	hydroxide	$Co(OH)_3$	109.96	black
10	oxide	Co_2O_3	165.88	black
11	potassium nitrite	$2Co(NO_2)_3.6KNO_2.3H_2O$	958.60	yel. pr.
12	sulfate	$Co_2(SO_4)_3$	406.07	blue cryst.
13	sulfide	Co_2S_3	214.07	blk. cryst.
14	sulfide di-	CoS_2	123.07	black
15	Cobalto cobaltic oxide	Co_3O_4	240.82	reg. blk.
16	Cobaltous acetate	$Co(C_2H_3O_2)_2.4H_2O$	249.05	red-violet cryst.
17	ammonium chloride	$CoCl_2.NH_4Cl.6H_2O$	291.45	red
18	ammonium sulfate	$CoSO_4.(NH_4)_2SO_4.6H_2O$	395.24	
19	arsenate	$Co_3(AsO_4)_2.8H_2O$	598.87	red monocl.
20	arsenite	$Co_3H_6(AsO_3)_4.H_2O$	692.72	rose red
21	bromate	$Co(BrO_3)_2.6H_2O$	422.87	octahdr.
22	bromide	$CoBr_2$	218.77	green
23	bromide	$CoBr_2.6H_2O$	326.88	red prisms
24	carbonate	$CoCO_3$	118.94	rhbdr., red
25	carbonate basic	$2CoCO_3.3Co(OH)_2$	516.75	red
26	chlorate	$Co(ClO_3)_2.6H_2O$	333.95	regular
27	chloride	$CoCl_2$	129.85	blue cryst.
28	chloride	$CoCl_2.6H_2O$	237.95	red monocl.
29	chromate	$CoCrO_4$	174.95	yel.-brown
30	cyanide	$Co(CN)_2.2H_2O$	146.99	buff
31	ferricyanide	$Co_3[Fe(CN)_6]_2$	600.60	red
32	ferrocyanide	$Co_2Fe(CN)_6.7H_2O$	455.88	gray-grn.
33	fluoride	$CoF_2.2H_2O$	132.97	rose red, cryst.
34	fluoride	$CoF_2.5HF.6H_2O$	305.08	trimet. prisms
35	hydroxide	$Co(OH)_2$	92.96	rose red, rhombic
36	iodate	$Co(IO_3)_2$	408.80	
37	iodide	CoI_2	312.80	
38	iodide	$CoI_2.2H_2O$	348.84	green
39	iodide	$CoI_2.6H_2O$	420.90	red
40	nitrate	$Co(NO_3)_2.6H_2O$	291.05	red monocl.
41	oxalate	$CoC_2O_4.2H_2O$	182.97	reddish wh.
42	oxide	CoO	74.94	brown
43	perchlorate	$Co(ClO_4)_2$	257.85	red need.
44	phosphate	$Co_3(PO_4)_2$	366.87	reddish
45	phosphate	$Co_3(PO_4)_2.8H_2O$	511.00	
46	phosphite	$CoHPO_3.2H_2O$	175.01	reddish

INORGANIC COMPOUNDS (Continued)

Sp. Gr. $H_2O = 1$ (A) air = 1 (D) $H_2 = 1$	Melting-point, Deg. C.	Boiling-point, Deg. C.	Solubility in 100 parts of		
			Cold water	Hot water	Alcohol, acids, etc.
7.25$^{18°}$	.....	.....	dec.	dec.	s. HNO_3
2.94	subl.	.....	s.	s.	
.....	.....	.....	s.	.....	s. a., al.
.....	.....	.....	v. s.	.....	s. a.; i. al.
1.802$^{15°}$	.....	.....	0.232$^{0°}$	1.031$^{46.6°}$	i. al.
1.7016$^{20°}$	.....	.....	4.26$^{0°}$	12.74$^{46.5°}$	i. al., NH_4OH
.....	.....	.....	16.12$^{0°}$	24.87$^{16°}$	sl. s. HCl
.....	.....	.....	dec.		
.....	.....	.....	i.	i.	i. al.; s. a.
5.18	.....	.....	i.	i.	s. a.
.....	.....	.....	sl. s.	.....	i. al., eth.
.....	.....	.....	dec.	.....	s. H_2SO_4
4.8	.....	.....	i.	.....	d. a.
4.269	.....	.....	i.	.....	s. HNO_3, aq. rg.
5.8–6.3	.....	.....	i.	i.	s. a.
1.7043$^{18.7°}$	.....	.....	s.	s.	s. a.
.....	.....	.....	deliq.	v. s.	
1.902$^{14°}$	.....	.....	20.5$^{20°}$	45.4$^{80°}$	i. al.
2.948	.....	.....	i.	i.	s. a., NH_4OH
.....	.....	.....	i.	.....	s. a.
.....	.....	.....	45.5$^{17°}$	.....	s. NH_4OH
1.909$^{2}_{4}{}^{5°}$	d.	.....	66.7$^{59°}$	68.1$^{97°}$	s. a., eth.
.....	100	.....	deliq.	153.2$^{77°}$	s. a., eth.
4.13	d.	.....	i.	i.	s. a.
.....	.....	.....	i.	dec.	s. $(NH_4)_2CO_3$
.....	50	d. 100	558.3$^{0°}$	s.	s. al.
3.348$^{2}_{4}{}^{5°}$	subl.	.....	45$^{7°}$	105$^{93°}$	3^{1} al., 8.6 acet.
1.84	86.75	$-6H_2O$, 110	76.7$^{0°}$	190.7$^{100°}$	v. s. eth.
.....	d.	.....	i.	.....	s. a., NH_4OH, dil. HNO_3
.....	$-2H_2O$, 280	.....	i.	.....	s. KCN, HCl, NH_4OH
.....	.....	.....	i.	.....	i. HCl; s. NH_4OH
.....	.....	.....	i.	.....	i. HCl; s. KCN
anh. 4.43	.....	.....	s.	dec.	s. HF
2.086					
3.597$^{15°}$	.....	.....	i.	i.	i. alk.; s. NH_4 salts
5.008$^{18°}$	.....	.....	0.4$^{15°}$	1.33$^{100°}$	s. HCl, HNO_3
.....	.....	.....	159$^{8°}$	420$^{100°}$	v. s. al.
.....	.....	.....	deliq.		
1.33$^{14°}$	56	d.	133.8$^{0°}$	.....	100$^{12.5°}$ al.
anh. 2.325$^{19°}$	.....	.....	i.	.....	s. a., NH_4OH
5.68	$-O$, 2860	.....	i.	i.	s. a., NH_4OH; i. al.
3.327	.....	.....	100$^{0°}$	115$^{45°}$	s. al., acet.
.....	.....	.....	i.	i.	s. H_3PO_4, NH_4OH
.....	.....	.....	i.	i.	s. H_3PO_4

	Name	Formula	Mol. wt.	Crystalline form and color
1	Cobaltous potassium carbonate	$CoCO_3.KHCO_3.4H_2O$...	291.11	rose cryst.
2	selenide	$CoSe$	138.14	yel. cryst.
3	silicate	Co_2SiO_4	209.94	violet
4	sulfate	$CoSO_4$	155.00	red powd.
5	sulfate	$CoSO_4.7H_2O$	281.12	red rhomb. or monocl.
6	sulfide	CoS	91.00	brown need.
7	sulfite	$CoSO_3.5H_2O$	229.08	red
8	Columbic acid	$3Cb_2O_5.7H_2O$	924.71	
9	Columbium (Niobium)	Cb	93.10	steel gray
10	bromide	$CbBr_5$	492.68	purp. red
11	chloride penta-	$CbCl_5$	270.39	yel. need.
12	hydride	CbH	94.11	gray powd.
13	nitride	CbN	107.11	black
14	oxalate	$Cb(HC_2O_4)_5$	538.14	monocl.
15	oxide mono-	CbO	109.10	reg.
16	oxide di-	CbO_2	125.10	black
17	oxide penta-	Cb_2O_5	266.20	cryst.
18	oxybromide	$CbOBr_3$	348.85	yel. cryst.
19	oxychloride	$CbOCl_3$	215.47	need.
20	oxysulfide	Cb_2OS_3	298.39	black
21	Copper	Cu	63.57	red cryst.
22	boride	Cu_3B_2	212.35	yellow
23	hydride	Cu_2H_2	129.16	red-brown
24	nitride	Cu_3N	204.72	
25	peroxide	$CuO_2.H_2O$	113.59	olive grn.
26	suboxide	Cu_4O	270.28	olive grn.
27	Cupric acetate	$Cu(C_2H_3O_2)_2.H_2O$	199.63	dk. grn.
28	aceto-arsenite	$(CuOAs_2O_3)_3.Cu(C_2H_3O_2)_2$	1014.09	green
29	ammonium chloride	$CuCl_2.2NH_4Cl.2H_2O$	242.05	lt. blue rhbdr. or monocl.
30	ammonium sulfate	$CuSO_4.4NH_3.H_2O$	245.78	rhombic blue
31	arsenate	$Cu_3(AsO_4)_2.4H_2O$	540.69	bluish grn.
32	arsenate, acid	$Cu_5H_2(AsO_4)_4.2H_2O$	911.74	blue
33	arsenide	Cu_5As_2	467.77	bluish octahdr.
34	arsenite (Paris green)	$CuHAsO_3$	187.54	green
35	bromate	$Cu(BrO_3)_2.5H_2O$	409.48	blue-grn. cryst.
36	bromide	$CuBr_2$	223.40	black

ORGANIC COMPOUNDS (Continued)

Sp. Gr. $H_2O = 1$ (A) air = 1 (D) H_2 = 1	Melting-point, Deg. C.	Boiling-point, Deg. C.	Solubility in 100 parts of		
			Cold water	Hot water	Alcohol, acids, etc.
.....	.....	.....	dec.		
7.65					
4.63	.....	.....	i.	.....	d. HCl
$3.472^{15°}$	98.9	d. 880	$26.2^{8°}$	$82.6^{100°}$	$1.04^{18°}$ meth. al.
$1.918^{15°}$	96.8	$-7H_2O$, 420	$60.4^{8°}$	s.	$2.5^{8°}$ al.
$5.45^{18°}$	>1100	.....	0.00038	.....	s. a., aq. rg., al.
.....	.....	.....	i.	.....	s. H_2SO_3
.....	.....	.....	i.	.....	s. KOH, HF, H_2SO_4
$7.06\frac{1}{4}^{°}$	1950, ign.	.....	i.	i.	sl. s. HCl, HNO_3, aq. rg.; s. hot H_2SO_4
$2.75^{20°}$	194	240.5	dec.	.....	s. CCl_4, al., HCl
6.0–.6	d.	.....	.....	.....	s. HF; i. a.
.....	.....	.....	.....	.....	i. HNO_3; s. HF+HNO_3
.....	.....	.....	dec.	dec.	d. al.; s. $H_2C_2O_4$
6.3–.7					
.....	.....	.....	i.	.....	i. HNO_3; s. H_2SO_4
4.4–.5	.....	.....	i.	.....	s. H_2SO_4, HF
.....	subl.	.....	dec.	.....	s. a.
.....	subl. 400	.....	dec.	.....	s. H_2SO_4, al.
.....	.....	.....	i.	.....	s. H_2SO_4
8.91–.96	1083	2310	i.	i.	s. HNO_3, h. H_2SO_4
8.116					
.....	d. 60	.....	.....	.....	s. HCl
.....	d. 300	.....	.....	.....	d. a.
.....	.....	.....	i.	.....	s. a.
.....	.....	.....	i.	.....	d. a.
1.9	d. 240	.....	7.2	20	7.143 al.; s. eth.
.....	.....	.....	i.	.....	s. a., NH_4OH
1.96–.97	$-2H_2O$, 120	.....	$33.8^{0°}$	$99.3^{30°}$	s. a.
.....	d. 150	.....	$18.5^{21.5°}$	dec.	i. al.
.....	.....	.....	i.	i.	s. a., NH_4OH
.....	.....	.....	i.	.....	s. a., NH_4OH
7.56	d.	.....	i.	i.	s. HNO_3, aq. rg.
.....	d.	.....	i.	i.	s. a., NH_4OH
2.583	$-5H_2O$, 200	.....	v. s.		
.....	d.	.....	v. s.	.....	i. bz.

	Name	Formula	Mol. wt.	Crystalline form and color
1	Cupric carbonate basic (malachite)	$CuCO_3.Cu(OH)_2$	221.16	dk. grn. monocl.
2	carbonate (azurite)	$2CuCO_3.Cu(OH)_2$	344.73	blue monocl.
3	chlorate	$Cu(ClO_3)_26H_2O$	338.58	grn. octahdr.
4	chloride	$CuCl_2$	134.48	br. yellow
5	chloride	$CuCl_2.2H_2O$	170.52	blue rhombic
6	chromate, basic	$CuCrO_4.2CuO.2H_2O$	374.75	yellow-br.
7	cyanide	$Cu(CN)_2$	115.59	yellow grn.
8	dichromate	$CuCr_2O_7.2H_2O$	315.62	blk. cryst.
9	ferricyanide	$Cu_3[Fe(CN)_6]_2$	614.49	yel.-grn.
10	ferrocyanide	$Cu_2Fe(CN)_6.7H_2O$	465.14	red br.
11	fluoride	$CuF_2.2H_2O$	137.60	pale bl. monocl.
12	fluosilicate	$CuSiF_6.6H_2O$	313.73	blue
13	formate	$Cu(CHO_2)_2$	153.59	blue monocl.
14	hydroxide	$Cu(OH)_2$	97.59	blue cryst.
15	iodate	$Cu(IO_3)_2$	413.43	grn. monocl.
16	iodate	$Cu(IO_3)_2.H_2O$	431.45	blue tricl.
17	iodate	$Cu(IO_3)_2.2H_2O$	449.47	grn.-blue
18	iodate, basic	$CuOHIO_3$	255.51	grn. orthorhombic
19	lactate	$Cu(C_3H_5O_3)_2.2H_2O$	277.68	dk. blue monocl.
20	nitro prusside	$CuFe(CN)_5NO.2H_2O$	315.49	greenish
21	nitrate	$Cu(NO_3)_2.3H_2O$	241.63	blue prism.
22	nitrate	$Cu(NO_3)_2.6H_2O$	295.68	blue cryst.
23	oxalate	$CuC_2O_4.\frac{1}{2}H_2O$	160.58	bl. white
24	oxide	CuO	79.57	reg. monocl., blk.
25	oxychloride	$CuCl_2.2CuO.4H_2O$	365.69	bl.-grn.
26	periodate	Cu_2HIO_6	351.08	grn. powd.
27	phosphate	$Cu_3(PO_4)_2.3H_2O$	434.81	rhombic blue
28	phosphide	Cu_3P_2	252.76	black
29	phosphite	$CuHPO_3.2H_2O$	179.64	
30	salicylate	$Cu(C_7H_5O_3)_2.4H_2O$	409.71	bl.-grn. need.
31	sulfate	$CuSO_4$	159.63	grn.-white powd.
32	sulfate (blue vitriol)	$CuSO_4.5H_2O$	249.71	tricl. blue
33	sulfide	CuS	95.63	blk. hex.
34	tartrate	$CuC_4H_4O_6.3H_2O$	265.65	lt. grn.
35	Cuprous ammonium iodide	$CuI.NH_4I.H_2O$	353.49	rhombic plates
36	bromide	Cu_2Br_2	286.97	brown
37	carbonate	Cu_2CO_3	187.14	yellow
38	chloride	Cu_2Cl_2	198.05	wh. tetrahdr.

INORGANIC COMPOUNDS (Continued)

Sp. Gr. $H_2O = 1$ (A) air = 1 (D) $H_2 = 1$	Melting-point, Deg. C.	Boiling-point, Deg. C.	Solubility in 100 parts of		
			Cold water	Hot water	Alcohol, acids, etc.
3.7–4.0	d.	.....	i.	dec.	0.026 CO_2 water; s. KCN
3.88	d.	.....	i.	dec.	s. NH_4OH, h. $NaHCO_3$ aq.
.....	65	d. 100	$207^{0°}$	v. s.	s. al.
3.054	498	d.	$70.6^{0°}$	$107.9^{100°}$	$53^{15°}$ al.; $68^{15°}$ meth. al.
2.47–.54	$-2H_2O$, 100	d.	$110.4^{0°}$	$192.4^{106°}$	s. al., eth., NH_4Cl
.....	$-2H_2O$, 260	.....	i.	.....	s. HNO_3, NH_4OH
.....	d.	.....	i.	.....	s. KCN
$2.286^{18°}$	.....	.....	deliq.	dec.	s. a., NH_4OH
.....	.....	.....	i.	.....	i. HCl; s. NH_4OH
.....	.....	.....	i.	i.	s. NH_4OH
.....	.....	.....	sl. s.	dec.	s. al., HCl, HNO_3, HF
2.182	.....	.....	$2.32^{17°}$	.....	$0.16^{20°}$ al.
1.831	.....	.....	12.5	dec.	0.25 al.
3.368	d.	.....	i.	dec.	s. a., al., NH_4OH, KCN
$5.241^{15°}$	d.	.....	$0.1364^{25°}$	i.	s. dil. H_2SO_4.
$4.876^{15°}$	d. 290	.....	$0.1424^{25°}$	i.	i. dil. HNO_3
.....	d.	.....	$0.33^{15°}$	$0.65^{100°}$	s. HCl, NH_4OH
$4.878^{15°}$	d. 290	.....	i.	i.	s. dil. H_2SO_4
.....	.....	.....	16.7	$45^{100°}$	0.9 c., 4 h., al.
.....	.....	.....	i.	.....	d. alk.
2.174	114.5	d. 170	$137.8^{0°}$	$1270^{100°}$	$100^{12.5°}$ al.
2.074	26.4	d.	$243.7^{0°}$	∞	s. al.
.....	.....	.....	i.	.....	i. acet. a.
6.3–.4	1064	$-O$, 1040	i.	i.	s. a., NH_4Cl, KCN
.....	$-3H_2O$, 140	.....	i.	.....	s. a.
.....	d., 110	.....	i.	i.	s. dil. HNO_3
.....	.....	.....	sl. s.	.....	s. a., NH_4OH
6.67	.....	.....	i.	.....	i. HCl; s. HNO_3
.....	d.	.....	i.	i.	
.....	.....	.....	v. s.	.....	v. s. al.
$3.516^{30°}$	d. 621	.....	$20^{0°}$	$194^{100°}$	i. al.
$2.284^{15°}$	$-4H_2O$, 110	$-5H_2O$, 230	$31.61^{0°}$	$203.3^{100°}$	i. al.
3.98	d. 220	.....	0.000033	.....	s. HNO_3, KCN
.....	d.	.....	$0.02^{15°}$	$0.14^{85°}$	
.....	.....	.....	dec.	dec.	s. NH_4I
4.72	484	861–954	i.	i.	s. HBr, HCl, NH_4OH
.....	d.	.....	i.	i.	s. a., NH_4OH
3.53	422	954–1032	sl. s.	.....	s. HCl, NH_4OH

	Name	Formula	Mol. wt.	Crystalline form and color
1	Cuprous cyanide	$Cu_2(CN)_2$	179.16	wh. monocl.
2	fluoride	Cu_2F_2	165.14	red cryst.
3	ferricyanide	$Cu_3Fe(CN)_6$	402.60	br.-red
4	ferrocyanide	$Cu_4Fe(CN)_6$	466.17	br.-red
5	hydroxide	$CuOH$	80.58	yellow
6	iodide	Cu_2I_2	381.00	
7	oxide	Cu_2O	143.14	reg. red
8	phosphide	Cu_3P_2	443.47	gray blk.
9	sulfide	Cu_2S	159.20	rhombic blk.
10	sulfite	$Cu_2SO_3.H_2O$	225.22	red
11	sulfocyanate	$CuCNS$	121.64	white
12	Cyanogen	C_2N_2	52.02	gas
13	Cyanogen compounds	*see organic tables*		
14	Dysprosium	Dy	162.52	
15	acetate	$Dy(C_2H_3O_2)_3.4H_2O$	411.66	yel. need.
16	bromate	$Dy(BrO_3)_3.9H_2O$	708.41	yel. hex. need.
17	carbonate	$Dy_2(CO_3)_3.4H_2O$	577.10	
18	chloride	$DyCl_3$	268.89	yel. plates
19	chromate	$Dy_2(CrO_4)_3.10H_2O$	853.23	yel. cryst.
20	oxalate	$Dy_2(C_2O_4)_3.10H_2O$	769.20	prisms
21	phosphate	$DyPO_4.5H_2O$	347.63	yellow
22	selenate	$Dy_2(SeO_4)_3.8H_2O$	898.77	yel. need.
23	Erbium	Er	167.70	
24	chloride	$ErCl_3.6H_2O$	382.17	
25	nitrate	$Er(NO_3)_3.6H_2O$	461.82	cryst.
26	oxide	Er_2O_3	383.40	
27	sulfate	$Er_2(SO_4)_3$	623.59	
28	sulfate	$Er_2(SO_4)_3.8H_2O$	767.72	
29	Ferric acetate, basic	$FeOH(C_2H_3O_2)_2$	190.90	amor.
30	arsenate	$FeAsO_4.2H_2O$	230.83	rhombic, wh.
31	arsenite, basic	$2FeAsO_3.Fe_2O_3.5H_2O$	607.36	br.-yel.
32	bromide	$FeBr_3$	295.59	dk. red cryst.
33	chloride	$FeCl_3$	162.21	hex., blk.-br.
34	chloride	$FeCl_3.6H_2O$	270.31	red-yel.
35	ferrocyanide (Prussian blue)	$Fe_4[Fe(CN)_6]_3$	859.02	dk. bl. cryst.
36	fluoride	FeF_3	112.84	grn., rhombic
37	fluoride	$FeF_3.4\frac{1}{2}H_2O$	193.91	yel. cryst.
38	formate	$Fe(CHO_2)_3.H_2O$	208.88	yel. cryst.
39	hydroxide	$Fe(OH)_3$	106.86	red-br.
40	hypophosphite	$Fe(H_2PO_2)_3$	250.97	
41	lactate	$Fe(C_3H_5O_3)_3$	322.96	brn. amor.
42	nitrate	$Fe(NO_3)_3.9H_2O$	404.01	rhombic
43	oxalate	$Fe_2(C_2O_4)_3$	375.68	amor.

INORGANIC COMPOUNDS (Continued)

Sp. Gr. $H_2O = 1$ (A) air = 1 (D) $H_2 = 1$	Melting-point, Deg. C.	Boiling-point, Deg. C.	Solubility in 100 parts of		
			Cold water	Hot water	Alcohol, acids, etc.
.....	.....	.....	i.	i.	s. HCl, NH_4OH, KCN
.....	908	.....	i.	.....	s. HNO_3, HCl; i. al
.....	.....	.....	i.	.....	s. NH_4OH; i. HCl
.....	.....	.....	i.	.....	s. NH_4OH; i. NH_4Cl
.....	$-\frac{1}{2}H_2O$, 360	.....	i.	i.	s. a., NH_4OH
5.65[15°]	606	759–72	0.0008[18°]	.....	i. a., al.; s. KI
5.88	1210	−O, 1800	i.	i.	s. NH_4OH, NH_4Cl, HCl
6.35–.75	.....	.....	i.	.....	s. HNO_3; i. HCl
5.58	1100	.....	0.00005	.....	s. HNO_3
3.83–4.46	.....	.....	sl s.	.....	s. NH_4OH, HCl; i. al., eth.
.....	1084	.....	0.023[18°]	.....	s. NH_4OH
1.8064 (A)	−39	−22	25 c.c.	.....	4.4 c.c. al.; s. eth.
.....	d. 120	.....	s.	.....	v. sl. s. al.
.....	78	$-6H_2O$, 110	v. s.	.....	sl. s. al.
.....	$-3H_2O$, 150	.....	i.		
3.67[°/4]	680				
.....	$-3\frac{1}{2}H_2O$, 150	d.	1.002[25°]		
.....	.....	.....	i.	.....	s. dil. a.
.....	$-5H_2O$, 200	.....	i.	.....	s. dil. a., acet a.
.....	$-8H_2O$, 200	.....	v. s.	.....	i. al.
4.77					
.....	.....	.....	deliq.	s.	s. al.
.....	.....	.....	s.	.....	s. al.
8.64	.....	.....	i.	.....	s. h. a.
3.678	d. 950	.....	43		
3.180	.....	.....	30[20°]	100[100°]	
.....	.....	.....	i.	.....	s. al., a.
3.18	d.	.....	i.	i.	s. HCl
.....	d.	.....	sl. s.	.....	s. a., alk.
.....	subl. d.	.....	s.	s.	s. al., eth.
2.804[11°]	298	.....	74.39[0°]	536.6[100°]	v. s. al., eth. + HCl
(A) 11.2[220°]	37	280–5	246[0°]	∞	s. al.
.....	d.	.....	i.	i.	s. HCl, H_2SO_4
3.18	.....	.....	sl. s.	s.	i. al., eth.; s. a.
.....	$-3H_2O$, 100	.....	sl. s.	s.	i. al.
.....	.....	.....	s.	dec.	
3.4–.9	$-1\frac{1}{2}H_2O$, 500	.....	i.	i.	i. al.; s. a.
.....	d.	.....	0.043[25°]	0.083[100°]	s. alk. citrate
.....	.....	.....	deliq.	v. s.	i. eth.
1.6835[30°]	47.2	d.	v. s.	v. s.	s. al.
.....	d. 100	.....	v. s.	v. s.	i. al.; s. a.

	Name	Formula	Mol. wt.	Crystalline form and color
1	Ferric oxide (hematite)	Fe_2O_3	159.68	red, hex., rhbdr. or reg.
2	phosphate	$FePO_4.4H_2O$	222.93	yel. rhomb. or monocl.
3	pyrophosphate	$Fe_4(P_2O_7)_3.9H_2O$	907.67	yel.
4	sulfate	$Fe_2(SO_4)_3$	399.87	amor.
5	sulfate	$Fe_2(SO_4)_3.9H_2O$	562.02	yel. rhomb.
6	(*See also under alum*)			
7	sulfide	Fe_2S_3	207.87	yel.-grn.
8	sulfocyanate	$Fe(CNS)_3.3H_2O$	284.10	dk. red, reg.
9	Ferroso-ferric chloride	$FeCl_2.2FeCl_3.18H_2O$	775.46	yel.
10 11 12	ferricyanide (Prussian green)	$Fe'''_4Fe''_3[Fe(CN)_6]_6$	1662.21	grn.
13	hydrate	$Fe_3O_4.4H_2O$	303.58	blk.
14 15	oxide (magnetic oxide)	Fe_3O_4	231.52	blk., octahdr.
16	sulfide	Fe_3S_4	295.78	hex.
17	Ferrous acetate	$Fe(C_2H_3O_2)_2.4H_2O$	245.95	need.
18	ammonium sulfate	$FeSO_4(NH_4)_2SO_4.6H_2O$	392.14	monocl., bl.-grn.
19	arsenate	$Fe_3(AsO_4)_2.6H_2O$	552.54	grn. amor.
20	arsenite	$Fe_2As_2O_5$	341.60	grn.-wh.
21	bromide	$FeBr_2$	215.67	
22	bromide	$FeBr_2.6H_2O$	323.77	rhomb., red.
23	carbonate	$FeCO_3$	115.84	rhbdr. gray
24	carbonate	$FeCO_3.H_2O$	133.86	amor.
25	chloride	$FeCl_2$	126.75	
26	chloride	$FeCl_2.4H_2O$	198.82	monocl. bl.-grn.
27	chloroplatinate	$FePtCl_6.H_2O$	481.83	yel. hex.
28	ferricyanide (Turnbull's blue)	$Fe_3[Fe(CN)_6]_2$	591.30	deep bl.
29	ferrocyanide	$Fe_2Fe(CN)_6$	323.57	amor. bl.-wh.
30	fluoride	$FeF_2.8H_2O$	237.97	grn.
31	formate	$Fe(CHO_2)_2.2H_2O$	181.89	
32	hydroxide	$Fe(OH)_2$	89.86	pa. grn. cryst.
33	iodide	$FeI_2.4H_2O$	381.77	grn. cryst.
34	lactate	$Fe(C_3H_5O_3)_2.3H_2O$	287.97	grn. cryst.
35	nitrate	$Fe(NO_3)_2.6H_2O$	287.95	cryst.
36	oxalate	$FeC_2O_4.2H_2O$	179.86	pa. yel. cryst.
37	oxide	FeO	71.84	black
38	perchlorate	$Fe(ClO_4)_2.6H_2O$	362.85	grn.
39	phosphate	$Fe_3(PO_4)_2.8H_2O$	501.70	monocl. bl.
40	potassium oxalate	$K_2Fe(C_2O_4)_2.2H_2O$	346.06	gold., need.
41	sulfate	$FeSO_4.7H_2O$	278.02	monocl. or rhombic, bl.-grn.
42	sulfide	FeS	87.90	blk. hex.
43	sulfite	$FeSO_3.2\frac{1}{2}H_2O$	180.94	
44	sulfocyanate	$Fe(CNS)_2.3H_2O$	226.03	grn. rhomb.
45	tartrate	$FeC_4H_4O_6$	203.87	cryst.
46	thiosulfate	$FeS_2O_3.5H_2O$	258.05	grn. cryst.
47	*See also under iron*			
48	Fluorine	F_2	38.00	grn.-yel.

INORGANIC COMPOUNDS (Continued)

Sp. Gr. $H_2O = 1$ (A) air = 1 (D) $H_2 = 1$	Melting-point, Deg. C.	Boiling-point, Deg. C.	Solubility in 100 parts of		
			Cold water	Hot water	Alcohol, acids, etc.
5.12–.30	1541	.....	i.	.....	s. HCl.
2.87	.....	.....	i.	0.067	i. acet. a.; s. min. a.
.....	.....	.....	i.	.....	s. a.
3.097$^{18°}$	d. 480	.....	sl. s.	dec.	i. H_2SO_4
2.0–.1	.....	.....	v. s.	dec.	s. abs. al.
4.25–.41	d.	.....	dec.	dec.	d. a.
.....	d.	.....	v. s.	v. s.	v. s. al., eth.
.....	d. 50	.....	deliq.		
.....	d. 180	.....	i.	.....	s. h. HCl
.....	d.	.....	i.	i.	s. a.
4.96–5.40	1538	.....	i.	i.	i. al.
4.51–.64	.....	.....	i.	.....	s. a.
.....	d.	.....	v. s.		
1.865	d.	.....	18$^{0°}$	78.2$^{75°}$	i. al.
.....	d.	.....	i.	i.	sl. s. NH_4OH; s. dil. HCl
.....	.....	.....	i.	.....	s. NH_4OH
4.636$^{25°}$	.....	.....	162$^{0°}$	177.8$^{100°}$	s. al.
.....	27	.....	313.2$^{0°}$	∞	s. al.
3.7–.9	d.	.....	i.	i.	s. CO_2 aq.
.....	d.	.....	sl. s.	.....	s. a., CO_2 aq.
2.988$^{18°}$	.....	.....	64.4$^{10°}$	105.7$^{100°}$	100 al.
1.926	.....	.....	160.1$^{10°}$	415.5$^{100°}$	s. al.
2.714	.....	.....	v. s.	v. s.	
.....	d.	.....	i.	.....	i. al., dil. a.
.....	.....	.....	i.		
4.09 anh.	$-8H_2O$, 100	.....	sl. s.	.....	s. HF; i. al., eth.; s. a.
.....	d.	.....	sl. s.		
.....	.....	.....	0.00067	.....	s. a., NH_4Cl
2.873	177 anh.	.....	v. s.	dec.	s. al.
.....	d.	.....	2.1$^{10°}$	8.5$^{100°}$	i. al.
.....	60.5	.....	200$^{0°}$	300$^{25°}$	
.....	d. 160	.....	0.022	0.026	s. a.
.....	1419	.....	i.	i.	s. a.; i. alk.
.....	d. <100	.....	s.	.....	s. al.
2.58–.68	.....	.....	i.	i.	s. a.; i. acet. a.
.....	d.	.....	s.	s.	
1.8987$^{14.8°}$	64, $-6H_2O$, 100	$-7H_2O$, 300	32.8$^{0°}$	196.4$^{78°}$	i. al.
4.84	1197	d.	0.00089	.....	s. a.
.....	d. 250	.....	sl. s.	.....	s. SO_2 aq.
.....	d.	.....	v. s.	.....	v. s. al., eth.
.....	.....	.....	0.877$^{16°}$		
.....	.....	.....	v. s.	dec.	v. s. al.
(A) 1.31$^{-50°}$	−223	−187	dec.	dec.	

	Name	Formula	Mol. wt.	Crystalline form and color
1	Fluosilicic acid	H_2SiF_6	144.08	
2	Formic acid	HCOOH	46.02	colorl. liq.
3	Gadolinium	Gd	157.26	
4	acetate	$Gd(C_2H_3O_2)_3.4H_2O$	406.40	tricl.
5	bromide	$GdBr_3.6H_2O$	505.10	rhomb. pl.
6	chloride	$GdCl_3$	263.63	pr. need.
7	chloride	$GdCl_3.6H_2O$	371.73	quad. pyram.
8	nitrate	$Gd(NO_3)_3.6\frac{1}{2}H_2O$	460.39	asym.
9	oxalate	$Gd_2(C_2O_4)_3.10H_2O$	758.68	monocl.
10	potassium sulfate	$Gd_2(SO_4)_3.K_2SO_4.2H_2O$	813.00	cryst.
11	selenate	$Gd_2(SeO_4)_3.8H_2O$	888.25	pearly monocl.
12	sulfate	$Gd_2(SO_4)_3$	602.71	
13	sulfate	$Gd_2(SO_4)_3.8H_2O$	746.84	monocl.
14	Gallium	Ga	69.72	gray, octahdr.
15	bromide	$GaBr_3$	309.47	cryst.
16	chloride di-	$GaCl_2$	140.63	wh. cryst.
17	chloride tri-	$GaCl_3$	176.09	wh. need.
18	hydroxide	$Ga(OH)_3$	120.74	
19	iodide	GaI_3	450.52	
20	nitrate	$Ga(NO_3)_3$	255.74	
21	oxide mono-	GaO	85.72	gray-bl.
22	oxide sesqui-	Ga_2O_3	187.44	
23	sulfate	$Ga_2(SO_4)_3$	427.63	wh.
24	sulfide	Ga_2S_3	235.63	wh.
25	Germanium	Ge	72.60	gray,-cubic.
26	bromide	$GeBr_4$	392.26	gray, reg., octhdr.
27	chloride di-	$GeCl_2$	143.51	
28	chloride tetra-	$GeCl_4$	214.43	liq.
29	chloroform	$GeHCl_3$	179.98	colorl. liq.
30	ethide	$Ge(C_2H_5)_4$	188.76	
31	fluoride	$GeF_4.3H_2O$	202.65	cryst.
32	iodide	GeI_4	580.33	yel.
33	oxide mono-	GeO	88.60	gray-blk.
34	oxide di-	GeO_2	104.60	rhombic, wh.
35	oxychloride	$GeOCl_2$	159.51	
36	sulfide mono-	GeS	104.66	rhombic or monocl.
37	sulfide di-	GeS_2	136.73	wh. powd.
38	Glucinum *see beryllium*			
39	Gold	Au	197.20	reg. yel.
40	colloidal	Au	197.20	bl.-violet
41	bromide (ic)	$AuBr_3$	436.95	dk.-br.
42	bromide (ous)	AuBr	277.12	yel.-grn.
43	chloride (ic)	$AuCl_3$	303.57	yel.-red cryst.
44	chloride (ic)	$AuCl_3.2H_2O$	339.60	orange.
45	chloride (ous)	AuCl	232.66	yel. cryst.
46	cyanide (ic)	$Au(CN)_3.6H_2O$	383.32	
47	cyanide (ous)	AuCN	223.21	yel. cryst.
48	hydrogen nitrate (ic)	$Au(NO_3)_3.HNO_3.3H_2O$	500.29	yel. tricl. octhdr.
49	hydroxide (ic)	$Au(OH)_3$	248 22	yel. br.
50	hydroxide (ous)	AuOH	214.21	red. br.
51	iodide (ic)	AuI_3	578.00	dk. grn.

INORGANIC COMPOUNDS (Continued)

Sp. Gr. $H_2O = 1$ (A) air = 1 (D) H_2 = 1	Melting-point, Deg. C.	Boiling-point, Deg. C.	Solubility in 100 parts of		
			Cold water	Hot water	Alcohol, acids, etc.
.....	.....	.....	s.	s.	
$1.218^{20°}$	8.6	100.8	∞	∞	
1.31					
1.611	.....	.....	sl. s.		
2.844	.....	.....	s.	s.	
$4.52^{0°}$	628	.....	s.	s.	
.....	.....	.....	s.	s.	
2.332	.....	.....	v. s.	v. s.	
.....	$-6H_2O$, 110	.....	0.11	.....	s. HNO_3
$1.503^{16°}$	.....	.....	s.	s.	s. K_2SO_4
3.309	$-8H_2O$, 130	.....	s.	s.	
$4.139^{14.6°}$	.....	.....	$3.98^{0°}$	$2.26^{34.4°}$	
3.010	.....	.....	s.	s.	
$5.95^{24°}$	30.15	.....	i.	i.	s. a., alk.
.....	.....	.....	deliq.	s.	
.....	164	535	deliq.	dec.	
$2.36^{\frac{20°}{4°}}$	75.5	220	deliq.	dec.	
.....	.....	.....	i.	.....	s. a., alk.
.....	.....	.....	deliq.	s.	
.....	d. 110	Ga_2O_3, 200	deliq.	v. s.	
.....	.....	.....	i.	.....	s. a.
.....	.....	.....	i.	.....	s. a.
.....	.....	.....	v. s.	v. s.	s. al.; i. eth.
$5.469^{\frac{18}{16}°}$	958	>1350	i.	i.	s. h. H_2SO_4, aq. reg.
.....	O ±	.....	dec.		
.....	.....	.....	dec.		
$1.887^{18°}$	.....	86	dec.	.....	i. h. H_2SO_4
.....	.....	72	i.	i.	
.....	.....	160	i.	.....	s. HCl
.....	d.	.....	deliq.	s.	
(A) $20.5^{440°}$	144	350–400	deliq.	s.	
.....	.....	.....	s.	.....	s. HCl
$4.703^{18°}$	.....	.....	$0.4^{20°}$	$1.05^{100°}$	s. a., alk.
.....	.....	>100	i.	.....	s. a.
(A) $3.54^{11000°}$	.....	.....	0.25	sl. s.	s. HCl, KOH
.....	.....	.....	0.45	sl. s.	i. a.; s. alk.
$19.32^{17.5°}$	1063.0	2500	i.	i	i. a.; s. KCN, aq. reg.
.....	.....	.....	s.	.....	i. a.; s. alk., aq. reg.
.....	.....	.....	s.	.....	s. eth.
.....	d. 115	.....	i.	i.	d. a.
3.9	d. 180	.....	68	v. s.	s. al., eth.
.....	d.	.....	s.	s.	s. al.
.....	d.	.....	dec.	dec.	
.....	.....	.....	v. s.	v. s.	s. al.
.....	d.	.....	i.	i.	i. a.; s. KCN
2.58	d.	.....	d.	.....	s. HNO_3
.....	$-1\frac{1}{2}H_2O$, 100	d. 250	i.	i.	s. HNO_3
.....	d. 250	.....	s.		
.....	.....	.....	i.	dec.	s. iodides

	Name	Formula	Mol. wt.	Crystalline form and color
1	Gold iodide (ous)	AuI	324.13	yel.
2	oxide (ic)	Au_2O_3	442.40	blk.
3	oxide (ous)	Au_2O	410.40	violet
4	phosphide	Au_2P_3	487.48	gray
5	sulfate (ic)	$Au_2O_3.2SO_3.H_2O$	620.54	
6	sulfide (ic)	Au_2S_3	490.59	br.
7	sulfide (ous)	Au_2S	426.46	blk.
8	Helium	He	4.00	
9	Hydrazine	$NH_2.NH_2$	32.05	cryst. wh. or liq.
10	azoimid	$N_2H_4.HN_3$	75.08	
11	dihydrochloride	$N_2H_4.2HCl$	104.98	reg.
12	formate	$N_2H_4.2HCOOH$	124.08	reg.
13	hydroxide	$N_2H_4.H_2O$	50.06	
14	sulfate	$N_2H_4.H_2SO_4$	130.13	tablets
15	nitrate	$N_2H_4.HNO_3$	95.06	
16	Hydrazoic acid	HN_3	43.03	liq.
17	Hydrobromic acid (hydrogen bromide)	HBr	80.92	colorl. gas
18	Hydrobromic acid	$HBr.H_2O$	98.94	colorl. liq.
19	Hydrobromic acid	$HBr.H_2O$(47.8%)	98.94	colorl. liq.
20	Hydrochloric acid (hydrogen chloride)	HCl	36.47	colorl. gas
21	Hydrochloric acid	$HCl.H_2O$(45.2%)	54.48	colorl. liq.
22	Hydrochloric acid	$HCl.8H_2O$(20.18%)	180.59	colorl. liq.
23	Hydrocyanic acid	HCN	27.02	colorl. liq. or gas
24	Hydroferricyanic acid	$H_3Fe(CN)_6$	214.91	grn. br. need.
25	Hydrofluoric acid (hydrogen fluoride)	HF	20.01	colorl. liq. or gas
26	Hydrofluoric acid	$HF.H_2O$(35.35%)	38.02	colorl. liq.
27	Hydriodic acid (hydrogen iodide)	HI	127.94	colorl. gas
28	Hydriodic acid	$HI.H_2O$(57%)	145.96	colorl. liq.
29	Hydrogen	H_2	2.016	colorl. gas
30	peroxide	H_2O_2	34.02	colorl. liq.
31	persulfide	H_2S_2	66 14	yel. oil
32	selenide	H_2Se	81.22	
33	sulfide	H_2S	34.08	colorl. gas
34	telluride	H_2Te	129.52	gas
35	Hydroxylamine	NH_2OH	33.03	cryst.
36	hydrochloride	$NH_2OH.HCl$	69.50	monocl.
37	nitrate	$NH_2OH.HNO_3$	96.05	
38	sulfate	$(NH_2OH)_2.H_2SO_4$	164.14	monocl.
39	Indium	In	114.80	reg. octhdr.
40	bromide	$InBr_3$	354.55	cryst.
41	chloride mono-	InCl	150.26	dk. red cryst.
42	chloride di-	$InCl_2$	185.71	cryst.
43	chloride tri-	$InCl_3$	221.17	
44	cyanide	$In(CN)_3$	192.82	

INORGANIC COMPOUNDS (Continued)

Sp. Gr. $H_2O = 1$ (A) air = 1 (D) H_2 = 1	Melting-point, Deg. C.	Boiling-point, Deg. C.	Solubility in 100 parts of		
			Cold water	Hot water	Alcohol, acids, etc.
.....	d. 120	.....	i.	sl. s.	s. exc. KI
.....	−O, 160; −3O, 250	.....	i.	i.	s. HCl
.....	d. 250	.....	i.	i.	s. HI, HCl, alk.
6.67	d.	.....	.....	.....	i. HCl
.....	.....	.....	deliq.	dec.	s. HCl, H_2SO_4
.....	.....	.....	i.	.....	s. Na_2S, K_2S; i. a.
.....	.....	.....	i.	.....	i. a.
(A) 0.1368 (D) 1.98	<−271	−267	1.487 c.c.$^{0.5°}$	1.371 c.c.$^{25°}$	absorb. Pt
1.013$^{15°}$	1.4	113	v. s.	.....	s. al.
.....	65	.....	deliq.	v. s.	v. s. al.
.....	198	.....	s.	v. s.	s. al.
.....	128	.....	s.		
1.0305$^{21°}$	<−40	119	∞	∞	∞ al.; i. eth.
.....	254	.....	sl. s.	v. s.	i. al.
.....	69				
.....	−80	37	∞	.....	s. al.
(A) 2.71$^{0°}$	−86.13	−68.7	221.2 c.c.$^{0°}$	130 c.c.$^{100°}$	s. al.
1.78					
1.49	−11	126	∞	∞	s. al.
(A) 1.269$^{0°}$	−112.5	−83.1	82.5$^{10°}$	56.1$^{60°}$	s. al., eth.
1.2257	.....	.....	∞	.....	s. al.
1.101	.....	110	∞	.....	s. al.
(A) 0.697$^{18°}$	−15	26.1	∞	∞	∞ al., eth.
.....	d.	.....	deliq.	s.	s. al.
(A) 0.7126$^{0°}$	−92.3	19.44	264 c.c.	v. s.	
1.15	.....	120	v. s.	v. s.	
(A) 4.38$^{0°}$	−51.3	−35.7	42,500 c.c.$^{10°}$	v. s.	s. al.
1.67	.....	127	∞	∞	∞ al.
(A) 0.06948	−259	−252.6	1.93 c.c.$^{0°}$	.....	s. Pd, Pt, Fe
1.458$^{0°}$	−2	80.2	∞	.....	s. al., eth.
1.734	−75	.....	d.	.....	s. CS_2, bz.; i. al.
.....	−64	−42	331 c.c.$^{12°}$	.....	s. CS_2
(A) 1.1895	−83.8	−60.2	437 c.c.$^{0°}$	186 c.c.$^{40°}$	9.54 c.c.$^{20°}$ al.
(D) 65.1	−57	0	s.		
1.227$^{14°}$	33.05	70^{60mm}	s.	dec.	s. al., a.
.....	151	d.	v. s.	.....	s. al.; i. eth.
.....	−10	d. >100	v. s.	dec.	v. s. al.
.....	170	.....	v. s.	s.	sl. s. al.
7.12$^{13°}$	155	700	i.	i.	s. a.
.....	.....	.....	deliq.	v. s.	
.....	.....	.....	deliq.	dec.	
.....	.....	.....	deliq.	dec.	
.....	.....	440	deliq.	v. s.	sl. s. al., eth.
.....	.....	.....	i.	.....	s. HCN

	Name	Formula	Mol. wt.	Crystalline form and color
1	Indium fluoride	$In_2F_6.18H_2O$	667.89	need
2	hydroxide	$In(OH)_3$	165.82	
3	iodide	InI_3	494.60	yel. cryst.
4	iodate	$In(IO_3)_3$	638.60	cryst
5	nitrate	$In(NO_3)_3.4\frac{1}{2}H_2O$	381.90	need
6	oxide mono-	InO	130.80	black
7	oxide sesqui-	In_2O_3	277.60	yel. amor. or rhombic
8	perchlorate	$In(ClO_4)_3.8H_2O$	557.30	cryst
9	sulfate	$In_2(SO_4)_3$	517.79	
10	sulfide	In_2S_3	325.79	yel
11	sulfite	$2In_2O_3.3SO_2.8H_2O$	891.52	cryst
12	Iodic acid	HIO_3	175.94	rhombic
13	Iodine	I_2	253.86	rhombic, blk
14	chloride mono-α	ICl	162.39	rhombic, red need.
15	chloride mono-β	ICl	162.39	red, br., rhombic plates
16	chloride, tri-	ICl_3	233.30	yel. cryst
17	fluoride	IF_5	221.93	liq
18	monobromide	IBr	206.85	dk. gray cryst
19	oxide di-	IO_2	158.93	yel. cryst
20	oxide penta-	I_2O_5	333.86	trim
21	Iodoplatinic acid, *see platinic*			
22	Iridium	Ir	193.10	white spongy
23	Iridium	Ir	193.10	reg. or hex. rhombic.
24	bromide tri-	$IrBr_3.4H_2O$	504.91	olive grn. cryst
25	bromide tetra-	$IrBr_4$	512.76	blue cryst
26	chloride di-	$IrCl_2$	264.01	blk.-grn. cryst
27	chloride tri-	$IrCl_3$	299.47	olive grn.
28	chloride tetra-	$IrCl_4$	334.93	dk. red cryst
29	hydroxide di-	$IrO_2.2H_2O$	261.13	ind. bl.
30	hydroxide sesqui-	$Ir_2O_3.3H_2O$	488.25	blk.
31	iodide tri-	IrI_3	573.90	blk. cryst
32	iodide tetra-	IrI_4	700.83	blk.
33	oxide di-	IrO_2	225.10	blk.
34	oxide sesqui-	Ir_2O_3	434.20	bl.-blk.
35	sulfide mono-	IrS	225.16	bl. blk.
36	sulfide di	IrS_2	257.23	blk.
37	sulfide sesqui-	Ir_2S_3	482.39	br. blk.
38	Iron cast	Fe	55.84	gray
39	pure	Fe	55.84	cubic. or octhdr. silvery
40	steel	Fe	55.84	gray
41	white pig	Fe	55.84	gray
42	wrought	Fe	55.84	
43	arsenide	FeAs	130.80	
44	arsenide di-	$FeAs_2$	205.76	silver gray

INORGANIC COMPOUNDS (Continued)

	Sp. Gr. $H_2O = 1$ (A) air = 1 (D) $H_2 = 1$	Melting-point, Deg. C.	Boiling-point, Deg. C.	Solubility in 100 parts of		
				Cold water	Hot water	Alcohol, acids, etc.
1	.....	d.	.....	sl. s.	dec.	s. HCl, HNO_3; i. al., eth.
2	.....	subl.	.....	i.	.....	s. a., alk.
3	.....	200	.....	deliq.		
4	.....	.....	d.	$0.067^{20°}$	.....	s. dil. H_2SO_4, HNO_3
5	.....	$-4\frac{1}{2}H_2O$, 10	d.	deliq.	s.	s. al.
6	.....	.....	.....	i.	.....	s. a.
7	7.179	.....	volt. 850	i.	.....	s. a.
8	.....	80	d. 200	s.	dec.	s. abs. al., eth.
9	3.438	.....	.....	deliq.	v. s.	
10	.....	.....	.....	.....	.....	d. ; s. $(NH_4)_2S$
11	.....	$-3H_2O$, 100	$-8H_2O$, 260	i.	.....	s. a.
12	$4.629^{0°}$	d. 170	.....	$286^{0°}$	$471^{80°}$	v. s. al., HNO_3
13	$4.948^{17°}$	112–5	184.35	$0.0182^{11°}$	$0.092^{55°}$	s. al., KI, eth.
14	$3.1822^{0°}_{4°}$	24.7	101.3	dec.	.....	s. al., eth., CS_2, acet. a
15	.....	13.9	101.3	dec.	.....	
16	3.1107	33	.....	s.	dec.	s. al., eth., HCl
17	3.5	8	97	dec.	dec.	dec. a.
18	.....	36	.....	sl. s.	.....	s. al., eth., CS_2
19	$4.21^{0°}_{8°}$	d. 130	.....	i.	dec.	i. al., eth.; s. H_2SO_4
20	$4.799^{2°}_{4°}$	d. 300	.....	$187.4^{13°}$	.....	i. al., eth., CS_2
21						
22	15.86	2300?	.....	i.	i.	s. aq. reg., $Cl_2.H_2O$
23	22.42	.....	.....	i.	i.	s. aq. reg., $Cl_2.H_2O$
24	.....	$-3H_2O$, 100	.....	s.	.....	i. al. etb.
25	.....	d.	.....	s.	.....	s. al.
26	.....	d.	.....	s.	.....	s. al.
27	.....	.....	.....	s.	.....	i. a., alk.
28	.....	d.	.....	s.	dec.	s. al., dil. HCl
29	.....	.....	.....	i.	.....	s. HCl, alk.
30	.....	.....	.....	i.	.....	i. a.
31	.....	.....	.....	sl. s.	s.	i. al.
32	.....	d. 360	.....	i.	i.	s. KI, NaI
33	.....	.....	.....	i.	.....	i. a., alk.
34	.....	$-O$, 400	.....	i.	.....	i. a., alk.
35	.....	d.	.....	i.	.....	i. a.; s. K_2S
36	.....	d.	.....	i.	.....	i. a.; s. K_2S
37	.....	d.	.....	sl. s.	.....	s. HNO_3, K_2S
38	7.03	1275	.....	i.	i.	s. a.
39	7.85–.88	1530	2450	i.	i.	s. a.; i. alk.
40	7.60–.80	1375	.....	i.	i.	s. a.; i. alk.
41	7.58–.73	1075	.....	i.	i.	s. a.; i. alk.
42	7.86	1505	.....	i.	i.	s. a.; i. alk.
43	7.83	1020				
44	7.38	980–1040	.....	i.	.....	i. HCl.; sl. s. HNO_3

	Name	Formula	Mol. wt.	Crystalline form and color
1	Iron boride	FeB	66.66	gray cryst.
2	carbide	Fe_3C	179.52	reg. gray
3	carbide	FeC_4	103.84	gray cryst.
4	carbonyl	$Fe(CO)_5$	195.84	liq.
5	disulfide	FeS_2	119.97	reg. or rhombic yel.
6	nitride	Fe_2N	125.69	
7	phosphide	Fe_2P	142.71	gray cryst.
8	Krypton	Kr	82.90	colorl. gas
9	Lanthanum	La	138.90	lead gray
10	bromate	$La_2(BrO_3)_6.18H_2O$	1369.58	hex. prisms
11	bromide	$LaBr_3.7H_2O$	504.76	
12	carbide	LaC_2	162.90	yel. cryst.
13	carbonate	$La_2(CO_3)_3.8H_2O$	601.93	trimet.
14	chloride	$LaCl_3$	245.27	wh. cryst.
15	chloride	$LaCl_3.7H_2O$	371.38	tricl.
16	nitrate	$La(NO_3)_3.6H_2O$	433.02	prisms., colorl.
17	oxalate	$La_2(C_2O_4)_3.9H_2O$	703.94	
18	oxide sesqui-	La_2O_3	325.80	amor. or rhombic, wh.
19	sulfate	$La_2(SO_4)_3$	565.99	
20	sulfate	$La_2(SO_4)_3.9H_2O$	728.14	hex. colorl.
21	sulfide	La_2S_3	373.99	red yel. cryst.
22	Lead	Pb	207.20	reg. or monocl. gray
23	acetate (sugar of lead)	$Pb(C_2H_3O_2)_2.3H_2O$	379.30	monocl. wh.
24	acetate basic	$Pb_2(C_2H_3O_2)_3OH$	608.48	
25	acetate basic	$Pb(C_2H_3O_2)_2.Pb(OH)_2.H_2O$	584.48	need.
26	acetate basic	$Pb(C_2H_3O_2)_2.2Pb(OH)_2$	807.68	need.
27	arsenate mono-	$PbH_4(AsO_4)_2$	489.15	rhombic pl.
28	arsenate di-	$PbHAsO_4$	347.17	monocl. leaf
29	arsenate meta-	$Pb(AsO_3)_2$	453.12	hex. tabl.
30	arsenate pyro-	$Pb_2As_2O_7$	676.32	ortho-rhombic cryst.
31	azoimide	PbN_6	291.25	cryst.
32	borate	$Pb(BO_2)_2.H_2O$	310.86	cryst.
33	bromate	$Pb(BrO_3)_2.H_2O$	481.05	monocl.
34	bromide	$PbBr_2$	367.03	rhombic colorl.
35	carbonate	$PbCO_3$	267.20	rhombic
36	carbonate basic (white lead)	$2PbCO_3.Pb(OH)_2$	775.62	amor. white
37	chlorate	$Pb(ClO_3)_2H_2O$	392.13	monocl.
38	chloride	$PbCl_2$	278.11	rhombic
39	chloride tetra-	$PbCl_4$	349.03	liq.
40	chlorite	$Pb(ClO_2)_2$	342.11	monocl. yel.
41	chromate	$PbCrO_4$	323.21	monocl. yel.
42 43	chromate, basic (chrome red)	$PbCrO_4.PbO$	546.41	red cryst.

INORGANIC COMPOUNDS (Continued)

	Sp. Gr. $H_2O = 1$ (A) air = 1 (D) $H_2 = 1$	Melting-point, Deg. C.	Boiling-point, Deg. C.	Solubility in 100 parts of		
				Cold water	Hot water	Alcohol, acids, etc.
	7.15$^{18°}$	.....	.....	i.	.....	s. HNO_3, h. H_2SO_4
2	7.07$^{16°}$	.....	.....	i.	i.	s. a.
3	.....	.....	.....	i.	i.	sl. s. HCl
4	1.47	−21	103	.....	.....	s. H_2SO_4, al., alk.
5	4.86–5.18	1171	d.	0.00049	.....	i. dil. a.
6	6.35	d. 200	.....	dec.	.....	s. HCl, H_2SO_4
7	6.57$^{15°}$	1290	.....	i.	i.	i. a.; s. HNO_3 + HF
8	(A) 2.818 (D) 40.78	−169	−151.7			
9	6.155	810?	.....	dec.	dec.	s. a.
0	.....	37.5	$-14H_2O$, 100	416$^{25°}$	.....	i. al.
1	.....	.....	.....	v. s.	.....	v. s. al.; i. eth.
2	5.02$^{20°}$	.....	.....	dec.	dec.	s. a.
3	.....	.....	.....	i.	.....	sl. s. CO_2 aq.
4	3.947$^{18°}$	890	.....	v. s.	dec.	v. s. al.
5	.....	.....	.....	v. s.	v. s.	v. s. al.
6	.....	40	126	deliq.	v. s.	v. s. al.
7	.....	.....	.....	0.00008$^{25°}$		
8	6.41$^{15°}$	.....	.....	sl. s. $La(OH)_3$	.....	s. al., a., NH_4Cl
9	3.60	d. 1150	.....	3.00$^{0°}$	0.87$^{100°}$	sl. s. al.
0	2.821	d.	.....	3.8$^{0°}$	1.06$^{100°}$	sl. s. HCl
1	4.91$^{111°}$	>1000	.....	i.	dec.	s. dil. a.
2	11.337$^{\frac{4}{4}°}$	327	1525	i.	i.	s. HNO_3
3	2.50	$-3H_2O$, 75	280	45.64$^{15°}$	200$^{100°}$	i. al.
4	.....	.....	.....	v. s.	.....	sl. s. al.
5	.....	.....	.....	v. s.	.....	v. s. al.
6	.....	.....	.....	5.55	18.2	s. al.
7	4.46$^{15°}$	d. 140	.....	dec.	.....	s. HNO_3
8	6.05$^{15°}$	$-H_2O$, 280	.....	i.	sl. s.	s. HNO_3
9	6.42$^{15°}$	.....	.....	dec.	dec.	s. HNO_3
0	6.85$^{15°}$	.....	.....	i.	dec.	
1	.....	.....	expl.	0.05	sl. s.	v. s. acet. a.
2	5.598 anh.	.....	$-H_2O$, 160	i.	i.	i. alk.; s. a.
3	.....	d. 180	.....	1.38$^{20°}$		
4	6.572$^{19.2°}$	380	861	0.455$^{0°}$	4.75$^{100°}$	s. a., KBr; i. al.
5	6.47	d.	.....	0.00198	dec.	i. al.; s. alk., a.
6	.....	d.	.....	i.	i.	sl. s. CO_2 aq.
7	4.037	d. 230	.....	171$^{18°}$	s.	
8	5.80	500	900	0.673$^{0°}$	3.34$^{100°}$	i. al., sl. s. dil. HCl
9	3.18$^{0°}$	−15	d. 105	dec.	dec.	
0	.....	.....	.....	sl. s.	s.	
1	6.123$^{15°}$	d. 600	.....	0.00002$^{18°}$	i.	s. a., alk.; i. acet. a.
2	.....	.....	.....	i.	i.	s. a., alk.

	Name	Formula	Mol. wt.	Crystalline form and color
1	Lead cyanate	$Pb(CNO)_2$	291.22	cryst.
2	cyanide	$Pb(CN)_2$	259.22	
3	dichromate	$PbCr_2O_7$	423.22	red cryst.
4	dithionate	$PbS_2O_6.4H_2O$	439.39	cryst.
5	ferricyanide	$Pb_3[Fe(CN)_6]_2.6H_2O$	1153.47	red cryst.
6	ferrocyanide	$Pb_2Fe(CN)_6.3H_2O$	680.34	
7	fluoride	PbF_2	245.20	
8	formate	$Pb(CHO_2)_2$	297.21	rhombic
9	hydroxide	$Pb(OH)_2$	241.22	white.
10	hydroxide	$3PbO.H_2O$	687.62	reg.
11	iodate	$Pb(IO_3)_2$	557.06	white.
12	iodide	PbI_2	461.06	hex. yel.
13	nitrate	$Pb(NO_3)_2$	331.22	wh. octhdr.
14	oxalate	PbC_2O_4	295.20	white.
15	oxide mono-	PbO	223.20	yel. rhombic
16	oxide mono-	PbO	223.20	red hex.
17	oxide mono-	PbO	223.20	amor.
18	oxide di-	PbO_2	239.20	hex. br.
19	oxide red (minium)	Pb_3O_4	685.60	scarlet, amor.
20	oxide sesqui-	Pb_2O_3	462.40	amor. red yel.
21	oxide sub-	Pb_2O	430.40	amor. blk.
22	oxychloride	$PbCl_2.PbO$	501.31	tetrag. wh.
23	oxychloride	$PbCl_2.2PbO$	724.51	yel. trim.
24	oxychloride	$PbCl_2.3PbO$	947.71	yel.
25	oxychloride (cossel yellow)	$PbCl_2.7PbO$	1840.51	yel. cryst.
26	perchlorate	$Pb(ClO_4)_2.3H_2O$	460.16	
27	periodate	$PbHIO_5$	415.14	cryst.
28	periodate	$PbHIO_5.H_2O$	433.16	amor.
29	persulfate	$PbS_2O_8.3H_2O$	453.38	
30	phosphate	$Pb_3(PO_4)_2$	811.65	wh.
31	phosphite	$PbHPO_3$	287.24	wh.
32	pyrophosphate	$Pb_2P_2O_7.H_2O$	606.47	rhombic
33	selenide	PbSe	286.40	reg.
34	sulfate	$PbSO_4$	303.26	rhombic wh.
35	sulfate, acid	$Pb(HSO_4)_2.H_2O$	419.36	cryst.
36	sulfate, basic	$PbSO_4.PbO$	526.46	
37	sulfide	PbS	239.26	blk. reg.
38	sulfite	$PbSO_3$	287.26	wh.
39	sulfochloride	$3PbS.PbCl_2$	995.91	red.
40	sulfocyanate	$Pb(CNS)_2$	323.34	monocl. yel.
41	thiosulfate	PbS_2O_3	319.33	
42	tungstate	$PbWO_4$	455.20	reg.
43	Lithium	Li	6.94	silv. gray
44	acetate	$LiC_2H_3O_2.2H_2O$	102.00	rhombic wh.
45	amide	$LiNH_2$	22.96	reg.

ORGANIC COMPOUNDS (Continued)

Sp. Gr. $H_2O = 1$ (A) air = 1 (D) H_2 = 1	Melting-point, Deg. C.	Boiling-point, Deg. C.	Solubility in 100 parts of		
			Cold water	Hot water	Alcohol, acids, etc.
.....	d.	.....	i.	sl. s.	
.....	.....	.....	sl. s.	s.	i. KCN
.....	.....	.....	dec.	.....	s. a., alk.
3.245	d.	.....	s.		
.....	d.	.....	sl. s.	s.	s. alk., HNO_3
.....	d.	.....	i.	.....	sl. s. H_2SO_4
8.24	.....	.....	$0.064^{18°}$	.....	s. HNO_3
4.571	d. 190	.....	$1.6^{18°}$	$18^{100°}$	i. al.
.....	d. 145	.....	sl. s.	sl. s.	s. a., alk.
7.592	$-H_2O$, 130	.....	0.014	.....	s. alk., a.
.....	.....	.....	$0.0012^{20°}$	.....	sl. s. HNO_3
6.12	358	861–954	$0.044^{0°}$	$0.436^{100°}$	i. al.; s. KI
4.531	d. 223	.....	$39^{0°}$	$139^{100°}$	$8.77^{22°}$ al.
5.025	d. 300	.....	$0.00016^{18°}$	.....	i. al.; s. HNO_3
9.375	888	.....	$0.017^{20°}$	.....	s. alk., lead acet., NH_4Cl, $CaCl_2$, $SrCl_2$
8.74	.....	.....	$0.0013^{22°}$	i.	
9.2–.5	.....	.....	i.	i.	
8.91	d. 290	.....	i.	i.	i. al.; s. acet. a.
9.07	d. 500	.....	i.	i.	s. acet. a.
.....	d. 370	.....	i.	dec.	s. a., alk.
8.342	.....	.....	i.	i.	s. a., alk.
7.21	.....	.....	i.	i.	s. alk.
7.0–.1	.....	.....	i.	.....	s. alk.
.....	.....	.....	$0.0056^{18°}$	$0.077^{4°}$	
.....	.....	.....	i.		
.....	.....	.....	s.	.....	s. al.
.....	d. 130	.....	i.	i.	s. dil. HNO_3
.....	$-H_2O$, 110	.....	i.	i.	sl. s. dil. HNO_3
.....	.....	.....	v. s.		
6.9–7.3	.....	.....	$0.000014^{20°}$	i.	s. HNO_3; i. acet. a.
.....	d.	.....	i.	i.	s. HNO_3
.....	806 anh.	.....	i.	dec.	s. HNO_3, KOH $Na_4P_2O_7$
8.10	1065	.....	i.	.....	s. HNO_3
6.23	>1100	.....	$0.0042^{20°}$	sl. s.	s. conc. a., NH_4 salts; i. al.
.....	.....	.....	sl. s.	.....	sl. s. H_2SO_4
.....	.....	.....	$0.0044^{0°}$	sl. s.	sl. s. H_2SO_4
7.48	1112	.....	0.0001	i.	s. a.; i. KOH
.....	.....	.....	i.	i.	s. HNO_3
.....	.....	.....	i.	dec.	i. dil. a.
3.82	.....	.....	$0.5^{20°}$	dec.	s. KCNS, HNO_3
.....	d.	.....	0.03	.....	s. $Na_2S_2O_3$
3.235	.....	.....	i.		
0.534	186	1400	dec.	dec.	s. a.
.....	70	d.	$300^{15°}$	v. s.	21.5 al.
1.178	374	430	dec.	dec.	

	Name	Formula	Mol. wt.	Crystalline form and color
1	Lithium benzoate	$LiC_7H_5O_2$	127.98	cryst.
2	bicarbonate	$LiHCO_3$	67.95	wh.
3	bichromate	$Li_2Cr_2O_7.2H_2O$	265.93	blk.-br. cryst.
4	borate	$Li_2B_4O_7.5H_2O$	259.24	
5	bromide	$LiBr$	86.86	cryst. wh.
6	carbide	Li_2C_2	37.88	cryst.
7	carbonate	Li_2CO_3	73.88	prisms.
8	chlorate	$LiClO_3.\frac{1}{2}H_2O$	99.41	tetrag.
9	chloride	$LiCl$	42.40	octhdr. wh.
10	chloroplatinate	$Li_2PtCl_6.6H_2O$	529.95	orange-red hex.
11	chromate	$Li_2CrO_4.H_2O$	147.91	red. trim.
12	citrate	$Li_3C_6H_5O_7.4H_2O$	281.92	cryst.
13	fluoride	LiF	25.94	tabl.
14	fluosilicate	$Li_2SiF_6.2H_2O$	191.97	monocl.
15	formate	$LiCHO_2.H_2O$	69.96	rhombic.
16	hydroxide	$LiOH$	23.95	wh. cryst.
17	iodide	LiI	133.87	cryst.
18	iodide	$LiI.3H_2O$	187.92	
19	nitrate	$LiNO_3$	68.95	rhombic, hex.,
20	nitrate	$LiNO_3.3H_2O$	123.00	rhbdr. or reg.
21	nitrite	$LiNO_2.H_2O$	70.96	flat need.
22	oxalate	$Li_2C_2O_4$	101.88	
23	oxalate, acid	$LiHC_2O_4.H_2O$	113.96	
24	oxide	Li_2O	29.88	cryst.
25	perchlorate	$LiClO_4$	106.40	
26	perchlorate	$LiClO_4.3H_2O$	160.45	rhbdr.
27	phosphate	$Li_3PO_4.H_2O$	133.86	rhbdr.
28	salicylate	$LiC_7H_5O_3$	143.98	
29	silicate	Li_2SiO_3	89.94	hex.
30	silicate	Li_4SiO_4	119.82	
31	silicide	$LiSi_2$	63.06	blue cryst.
32	sulfate	Li_2SO_4	109.94	monocl. reg., rhomb. or hex.
33	sulfate	$Li_2SO_4.H_2O$	127.96	monocl.
34	sulfate, acid	$LiHSO_4$	104.01	prism.
35	sulfide	Li_2S	45.94	
36	sulfite	$Li_2SO_3.6H_2O$	202.04	need.
37	urate	$LiHC_5H_2N_4O_3$	174.00	
38	Magnesium	Mg	24.32	silvery wh.
39	acetate	$Mg(C_2H_3O_2)_2.4H_2O$	214.43	monocl.
40	aluminate	$MgO.Al_2O_3$	142.26	
41	ammonium arsenate	$MgNH_4AsO_4.6H_2O$	289.42	tetrag.
42	ammonium chloride	$MgCl_2.NH_4Cl.6H_2O$	256.83	
43	ammonium chromate	$MgCrO_4.(NH_4)_2CrO_4.6H_2O$	400.52	yel. monocl.
44	ammonium phosphate	$MgNH_4PO_4.6H_2O$	245.48	tetrag.
45	ammonium sulfate	$MgSO_4.(NH_4)_2SO_4.6H_2O$	360.62	monocl. pr.
46	arsenate	$2MgHAsO_4.13H_2O$	562.78	
47	arsenite	$Mg_3(AsO_3)_2$	318.88	

ORGANIC COMPOUNDS (Continued)

Sp. Gr. $H_2O = 1$ (A) air = 1 (D) $H_2 = 1$	Melting-point, Deg. C.	Boiling-point, Deg. C.	Solubility in 100 parts of		
			Cold water	Hot water	Alcohol, acids, etc.
.....	.....	.....	$33^{25°}$	$40^{100°}$	$7.7^{25°}$, $10^{78°}$ al.
.....	.....	.....	$5.5^{13°}$		
.....	.....	.....	$168.3^{30°}$		
.....	.....	.....	v. s.	.....	i. al.
$3.446^{25°}_{4°}$	547	.....	$143^{0°}$	$270^{103°}$	s. al.
$1.65^{18°}$	.....	.....	dec.	.....	s. a.
2.111	695–710	d. 600	$1.539^{0°}$	$0.728^{100°}$	i. al.
.....	50	$-1\frac{1}{2}H_2O$, 90	$301^{18°}$	∞	v. s. al.
2.068	600	1360	$63.7^{0°}$	$129^{98°}$	$2.475^{25°}$ al.; s. eth.
.....	$-6H_2O$, 180	.....	s.	s.	s. al., eth.
.....	.....	.....	$132^{30°}$		
.....	d.	.....	$50^{25°}$	$66.7^{100°}$	sl. s. al., eth.
2.601	801	.....	$0.27^{18°}$	.....	s. HF
2.33	$-2H_2O$, 100	d.	52.6	.....	s. al.; i. eth.
1.43–.47	d.	.....	$61.67^{0°}$	$346.6^{104°}$	
.....	462	.....	$12.7^{0°}$	$17.5^{100°}$	sl. s. al.
$4.063^{25°}_{4°}$	330–446	.....	$151^{6°}$	$476^{99°}$	
.....	72				
2.334–.442	253–64	.....	$48.3^{0°}$	$227.3^{100°}$	s. al.
.....	29.8	.....	$138.4^{0°}$	∞	
$1.671^{21°}$	<100	d.	s.	v. s.	v. s. abs. al.
$2.121^{17.5°}$	d.	.....	819.5^{0}		
.....	d.	.....	$817^{0°}$		
$2.102^{15°}$	subl. 1000	.....	$5.22^{0°}$		
1.841	300	d. 400	s.	.....	s. al.
.....	95	$-2H_2O$, 100 $-3H_2O$, 150	s.	.....	s. al.
$2.41^{15°}$	857	$-H_2O$, 100	0.04	.....	s. a., NH_4Cl
.....	d.	.....	v. s.	.....	v. s. al.
$2.529^{15°}$	1201	.....	i.	s. d.	s. dil. HCl
2.39	1256	.....	i.	d.	
1.12	d.	.....	d.	d.	d. a.; i. turp.
$2.21^{15°}$	843–74	.....	$35.34^{0°}$	$29.24^{100°}$	i. 80% al.
$2.052^{20°}_{4°}$	$-H_2O$, 130	.....	$43.52^{0°}$	$35.75^{100°}$	i. 80% al.
2.123	120	.....	dec.		
1.66	.....	.....	v. s.	v. s.	v. s. al.
.....	.....	.....	s.	.....	sl. s. al.
.....	.....	.....	$0.27^{20°}$	$2.5^{100°}$	
$1.74^{15°}$	651	1120	i.	sl. s., d.	s. a., NH_4 salts
1.45	.....	.....	deliq.	v. s.	v. s. al.
$1.57^{15°}$					
.....	dec.	.....	$0.038^{20°}$	s.	i. al ; s. a.
.456	.....	.....	16.7		
$.829^{17°}$	.....	.....	v. s.	v. s.	
$.71^{15°}$	d.	.....	0.01322	s.	s. a.; i. al.
$.723^{20°}_{4°}$	.....	.....	$17.68^{0°}$	$130.58^{100°}$	
$.155^{15°}$	.....	.....	i.	0.15	s. HNO_3; i. NH_4Cl
.....	.....	.....	i.	.....	i. NH_4OH; s. NH_4Cl

	Name	Formula	Mol. wt.	Crystalline form and color
1	Magnesium benzoate	$Mg(C_7H_5O_2)_2.3H_2O$	320.45	wh. powd.
2	borate	$Mg(BO_2)_2.8H_2O$	254.09	
3	bromate	$Mg(BrO_3)_2.6H_2O$	388.25	reg.
4	bromide	$MgBr_2$	184.15	
5	bromide	$MgBr_2.6H_2O$	292.25	colorl. hex.
6	carbonate	$MgCO_3$	84.32	hex. rhbdr. or rhombic.
7	carbonate	$MgCO_3.3H_2O$	138.37	hex.
8	carbonate, basic	$3MgCO_3.Mg(OH)_2.3H_2O$	365.34	monocl.
9	chlorate	$Mg(ClO_3)_2.6H_2O$	299.33	
10	chloride	$MgCl_2$	95.23	hex.
11	chloride	$MgCl_2.6H_2O$	203.33	monocl.
12	chromate	$MgCrO_4.7H_2O$	266.44	yel.
13	ferrocyanide	$Mg_2Fe(CN)_6.12H_2O$	476.72	pa. yel. cryst.
14	fluoride	MgF_2	62.32	tetrag.
15	formate	$Mg(CHO_2)_2.2H_2O$	150.37	rhombic.
16	hydroxide (brucite)	$Mg(OH)_2$	58.34	rhbdr.
17	iodate	$Mg(IO_3)_2.4H_2O$	446.25	monocl.
18	iodide	MgI_2	278.18	
19	nitrate	$Mg(NO_3)_2.6H_2O$	256.43	monocl. or tricl.
20	nitride	Mg_3N_2	100.98	gr. yel. cryst.
21	oxalate	$MgC_2O_4.2H_2O$	148.35	wh.
22	oxide	MgO	40.32	reg. or hex.
23	permanganate	$Mg(MnO_4)_2.6H_2O$	370.28	purp. need.
24	phosphate	$Mg_3(PO_4)_2.4H_2O$	335.08	monocl.
25	phosphate,	$Mg_3(PO_4)_2.8H_2O$	407.14	monocl. pl.
26	phosphate, acid	$MgHPO_4.3H_2O$	174.40	plates.
27	phosphate, acid	$MgHPO_4.7H_2O$	246.47	hex.
28	phosphate, pyro-	MgP_2O_7	222.69	wh.
29	phosphate, pyro-	$Mg_2P_2O_7.3H_2O$	276.74	wh. amor.
30	phosphite	$MgHPO_3.3H_2O$	158.40	
31	potassium chloride	$MgCl_2.KCl.6H_2O$	277.88	hex.
32	potassium sulfate	$MgSO_4.K_2SO_4.6H_2O$	402.74	monocl. pr.
33	selenate	$MgSeO_4.6H_2O$	275.62	monocl.
34	silicide	Mg_2Si_3	205.78	
35	sodium chloride	$MgCl_2.NaCl.H_2O$	171.70	
36	sulfate	$MgSO_4$	120.38	
37	sulfate (epsom salt)	$MgSO_4.7H_2O$	246.50	tetrag. or monocl.
38	sulfide	MgS	56.38	cubic. br.
39	sulfite	$MgSO_3.6H_2O$	212.48	wh. cryst. powd.
40	tartrate	$MgC_4H_4O_6.4H_2O$	244.42	monocl.
41	thiosulfate	$MgS_2O_3.6H_2O$	244.54	prism.
42	Manganese	Mn	54.93	gr. pink
43	acetate	$Mn(C_2H_3O_2)_2.4H_2O$	245.04	monocl. pa. red
44	ammonium phosphate	$MnNH_4PO_4.H_2O$	186.01	wh. cryst.
45	ammonium sulfate	$MnSO_4.(NH_4)_2SO_4.6H_2O$	391.23	
46	arsenite	$Mn_3H_6(AsO_3)_4.2H_2O$	698.71	rose red.
47	benzoate	$Mn(C_7H_5O_2)_2.3H_2O$	351.06	flat prisms.
48	boride	MnB_2	76.57	gr. violet cryst.
49	bromide	$MnBr_2$	214.76	rose red.

ORGANIC COMPOUNDS (Continued)

Sp. Gr. $H_2O = 1$ (A) air = 1 (D) $H_2 = 1$	Melting-point, Deg. C.	Boiling-point, Deg. C.	Solubility in 100 parts of		
			Cold water	Hot water	Alcohol, acids, etc.
.....	d.	.....	$4.5^{25°}$	s.	
2.27	.....	.....	i.	i.	s. a.
2.29	$-6H_2O$, 200	d.	$71.5^{7°}$	v. s.	
.....	695	.....	$91.9^{0°}$	$120.2^{100°}$	
.....	165d.	.....	$316^{0°}$	v. s.	s. al.
3.04	d. 350	.....	0.0106	.....	s. a., CO_2 aq.
$1.808\frac{18°}{18°}$	.....	.....	$0.1518^{19°}$	dec.	s. a., CO_2 aq.
2.18	.....	.....	0.04	0.011	s. a., NH_4 salts
.....	40	.....	deliq.	v. s.	s. al.
2.177	708	.....	$52.2^{0°}$	$65.87^{80°}$	50 al.
$1.569^{17°}$	$-2H_2O$, 100	d.	167	367	50 al.
1.761	.....	.....	$211.5^{13°}$	v. s.	
.....	.....	.....	33		
2.472	1396	.....	$0.0087^{18°}$	i.	s. HNO_3; i. al.
.....	.....	.....	7.7	.....	i. al., eth.
$2.36^{15°}$	d.	.....	0.0009	.....	s. NH_4 salts
3.28	$-4H_2O$, 210	d.	$10^{15°}$	$33^{100°}$	
.....	d.	.....	$100^{0°}$	$164.9^{110°}$	s. al., eth.
1.464	90	$-5H_2O$, 330	200	∞	s. al.
.....	d.	.....	i.	dec.	s. a.; i. al.
.....	d.	.....	$0.07^{15°}$	$0.08^{100°}$	s. alk. oxal., a.
3.43	2800	.....	0.00062	.....	s. a., NH_4 salts
.....	d.	.....	v. s.	dec.	s. acet. a., meth. al.
$1.64^{15°}$	.....	.....	0.0205	.....	s. a.; i. NH_4 salts
$2.195^{15°}$					
$2.123^{15°}$					
.....	.....	.....	0.3	0.2	s. a.; i. al.
2.40	.....	.....	i.	i.	s. a.; i. al.
2.56	.....	.....	i.	i.	i. al.
.....	.....	.....	0.25	.....	s. a.
$2.0277\frac{0°}{4°}$	.....	.....	$19.26^{0°}$	$81.70^{75°}$	
1.928	.....	.....	v. s.		
.....	.....	.....	i.	dec.	d. a., NH_4Cl
.....	.....	.....	s.		
2.66	d.	.....	$26.9^{0°}$	$73.8^{100°}$	s. al.
$1.678^{15°}$	d.	.....	$76.9^{0°}$	$671.2^{100°}$	s. al.
$2.82^{15°}$	d.	.....	dec.	.....	s. a.
.....	$-6H_2O$, 200	d.	1.25	0.83	i. al.
1.67	d.	.....	$0.8^{16°}$		
$1.818^{24°}$	$-3H_2O$, 170	d.	v. s.	v. s.	s. al.
7.42	1230	1900	dec.	dec.	s. dil. a.
1.6	.....	.....	3	.....	s. al.
.....	.....	.....	0.0031	0.05	i. al., NH_4 salts
$1.837\frac{4°}{4°}$	.....	.....	$51.3^{25°}$	v. s.	
.....	.....	.....	i.	.....	s. a.
.....	.....	.....	$6.55^{15°}$		
$6.04^{19°}$	.....	.....	i.	dec.	s. a.
.....	d.	.....	$127.3^{0°}$	$228^{100°}$	

	Name	Formula	Mol. wt.	Crystalline form and color
1	Manganese bromide.	$MnBr_2.4H_2O$	286.83	red monocl.
2	carbide	Mn_3C	176.79	tetrahdr.
3	carbonate	$MnCO_3$	114.93	rhbdr. rose
4	chloride	$MnCl_2$	125.84	
5	chloride	$MnCl_2.4H_2O$	197.91	rose. monocl.
6	chloride, per	$MnCl_4$	196.76	green
7	ferrocyanide	$Mn_2Fe(CN)_6.7H_2O$	447.86	
8	fluoride di-	MnF_2	92.93	red quad. pr.
9	fluoride sesqui-	$Mn_2F_6.6H_2O$	331.96	cryst.
10	fluosilicate	$MnSiF_6.6H_2O$	305.09	hex.
11	formate	$Mn(CHO_2)_2.2H_2O$	180.98	monocl.
12	hydroxide (ous)	$Mn(OH)_2$	88.95	hex. wh.
13	hydroxide (ic)	$Mn_2O_3.H_2O$	175.88	tetrag. br.
14	hypophosphite	$Mn(H_2PO_2)_2.H_2O$	203.03	rose red cryst.
15	iodide	$MnI_2.4H_2O$	380.86	rose red monocl.
16	lactate	$Mn(C_3H_5O_3)_2.3H_2O$	287.06	pa. red monocl.
17	nitrate	$Mn(NO_3)_2.6H_2O$	287.04	rose. monocl.
18	oxalate	$MnC_2O_4.2\frac{1}{2}H_2O$	187.97	wh. cryst.
19	oxide (ous)	MnO	70.93	reg. gray grn.
20	oxide (ic)	Mn_2O_3	157.86	reg. blk.
21	oxide, di-	MnO_2	86.93	tetrag. or rhomb. blk.
22	oxide, tri-	MnO_3	102.93	reddish
23	oxide, hept-	Mn_2O_7	221.86	dk. red oil.
24	oxide, ous, ic	Mn_3O_4	227.79	tetrag. blk.
25	phosphate (ous)	$Mn_3(PO_4)_2.7H_2O$	480.96	amor. reddish.
26	phosphate (ous) acid	$MnHPO_4.3H_2O$	205.01	cryst.
27	phosphide	MnP	85.96	dk. gray
28	phosphite	$MnHPO_3.H_2O$	152.98	reddish
29	pyrophosphate	$Mn_2P_2O_7$	283.91	
30	pyrophosphate	$Mn_2P_2O_7.3H_2O$	337.96	amor. wh. powd.
31	silicate	$MnSiO_3$	130.99	rose need.
32	silicide	$MnSi$	82.99	tetrahdr.
33	silicide, di-	$MnSi_2$	111.05	gray octahdr.
34	silicide (ous)	Mn_2Si	137.92	quad. pr.
35	sulfate (ic)	$Mn_2(SO_4)_3$	398.05	grn. cryst.
36	sulfate (ous)	$MnSO_4$	150.99	reddish
37	sulfate (ous)	$MnSO_4.H_2O$	169.01	
38	sulfate (ous)	$MnSO_4.2H_2O$	187.03	
39	sulfate (ous)	$MnSO_4.3H_2O$	205.04	
40	sulfate (ous) (common form)	$MnSO_4.4H_2O$	223.06	monocl. or rhombic rose
41	sulfate (ous)	$MnSO_4.5H_2O$	241.07	

INORGANIC COMPOUNDS (Continued)

Sp. Gr. $H_2O = 1$ (A) air = 1 (D) $H_2 = 1$	Melting-point, Deg. C.	Boiling-point, Deg. C.	Solubility in 100 parts of		
			Cold water	Hot water	Alcohol, acids, etc.
.....	110	d.	296.7$^{0°}$		
6.89$^{17°}$	.....	.....	dec.	dec.	s. a.
3.125–.66	d.	.....	0.013	.....	s. dil. a., CO_2 aq.
2.977$^{2\frac{1}{4}°}$	650	.....	62.16$^{100°}$	123.8$^{106.5°}$	s. al.; i. eth.
1.913	87.5	106	151$^{8°}$	∞	s. al.; i. eth
.....	.....	.....	s.	s.	s. eth.
.....	.....	.....	i.	.....	s. HCl; i. NH_4 salts
3.98	856	.....	i.	dec.	i. al., eth.; s. a.
3.54	d.	.....	v. s.	dec.	s. a.
1.904$^{17.5°}$	d.	.....	140	v. s.	s. al.
1.953	d.	.....	s.	s.	
3.258	d.	.....	i.	i.	s. a., NH_4 salts; i. alk.
4.335	d.	.....	i.	i.	s. h. H_2SO_4
.....	d.	.....	deliq.	v. s.	
.....	d.	.....	s.	v. s.	
1.82	25.8	129.4	426.4$^{0°}$	∞	v. s. al.
2.453$^{20°}$	d. 150	.....	0.05	0.08$^{100°}$	s. dil. a.
5.09–.18	.....	.....	i.	i.	s. a., NH_4Cl
4.325–.820	−O, 1080	.....	i.	i.	s. a.
5.026	−O, 535	.....	i.	i.	s. HCl
.....	d.	.....	s.	dec.	s. H_2SO_4
>1.84	<−20	expl.	v. s.	dec.	s. H_2SO_4
4.61	.....	.....	i.	i.	s. HCl
.....	.....	.....	sl. s.	.....	s. a.; i. al.
.....	.....	.....	sl. s.	dec.	s. a.; i. al.
5.39$^{2\frac{1}{4}°}$	.....	.....	i.	i.	sl. s. HNO_3
.....	−H_2O, 200	.....	al. s.	.....	s. $MnCl_2$. $MnSO_4$
3.5847$^{20°}$	.....	.....	i.	.....	s. a.
.....	.....	.....	i.		
3.35	1218	.....	i.	i.	
5.90$^{15°}$	.....	.....	i.	i.	i. a.
524$^{13°}$	.....	.....	i.	i.	i. HNO_3. H_2SO_4; s. HF, alk.
6.20$^{15°}$	.....	.....	i.	i.	s. HCl, NaOH; i. HNO_3
.....	d. 160	.....	deliq.	dec.	s. HCl, dil. H_2SO_4
2.954	700	d. 850	53.2$^{0°}$	67$^{75°}$	s. al.; i. eth.
2.845$^{15°}$	stable 57–117	.....	98.47$^{48°}$	79.77$^{100°}$	
2.526$^{15°}$	stable 40–57	.....	85.27$^{35°}$	106.8$^{55°}$	
2.356$^{15°}$	stable 30–40	.....	74.22$^{5°}$	99.31$^{57°}$	
2.107	stable 18–30	.....	105.3$^{0°}$	111.2$^{54°}$	i. al.
2.1006$^{14.5°}$	54	stable 8–18°	124.4$^{0°}$	142.1$^{54°}$	

PHYSICAL CONSTANTS OF

	Name	Formula	Mol. wt.	Crystalline form and color
1	Manganese sulfate (ous)	$MnSO_4.6H_2O$	259.09	
2	sulfate (ous)	$MnSO_4.7H_2O$	277.11	pa. red monocl. or rhombic.
3	sulfide (ic)	MnS_2	119.06	blk. reg.
4	sulfide (ous)	MnS	86.99	green cryst. or pinkish
5	sulfide (ous)	$3MnS.H_2O$	279.00	gray-pink
6	sulfocyanate	$Mn(CNS)_2.3H_2O$	225.12	
7	Manganocyanhydric acid	$H_4Mn(CN)_6$	215.01	
8	Mercuric acetate	$Hg(C_2H_3O_2)_2$	318.66	wh. scales
9	arsenate	$Hg_3(AsO_4)_2$	879.75	yel.
10	bromate	$Hg(BrO_3)_2.2H_2O$	492.47	cryst.
11	bromide	$HgBr_2$	360.44	wh. rhombic.
12	carbonate, basic	$2HgO.HgCO_3$	693.83	br.-red.
13	chlorate	$Hg(ClO_3)_2$	367.52	need.
14	chloride (corrosive sublimate)	$HgCl_2$	271.52	wh. rhombic.
15	chromate	$HgCrO_4$	316.62	dk. red trim.
16	cyanide	$Hg(CN)_2$	252.63	wh. tetrag.
17	fluoride	HgF_2	238.61	cryst.
18	fluosilicate	$HgSiF_6.HgO.3H_2O$	613.33	yel. need.
19	fulminate	$HgC_2N_2O_2$	284.63	octahdr.
20	hydroxide	$Hg(OH)_2$	234.63	
21	iodate	$Hg(IO_3)_2$	550.47	
22	iodide, red	HgI_2	454.47	tetrag. red
23	iodide, yellow	HgI_2	454.47	rhombic yel.
24	iodo bromide	$HgIBr$	407.46	rhombic yel.
25	iodo chloride	$HgICl$	363.00	rhombic yel. or tetrag. red
26	nitrate	$Hg(NO_3)_2$	324.63	wh. cryst.
27	nitride	Hg_3N_2	629.85	br. powd.
28	oxalate	HgC_2O_4	288.61	
29	oxide	HgO	216.61	yel. tetrag. pl. or red monocl. pr.
30	oxybromide	$HgBr_2.3HgO$	1010.27	yel. cryst.
31	oxychloride	$HgCl_2.3HgO$	921.35	yel. pr.
32	oxycyanide	$Hg(CN)_2.HgO$	469.24	need.
33	oxyfluoride	$HgF_2.HgO.H_2O$	473.24	yel. cryst.
34	oxyiodide	$HgI_2.3HgO$	1104.30	yel. br.
35	phosphate	$Hg_3(PO_4)_2$	791.88	wh. to yel.
36	potassium iodide	$2HgI_2.2KI.3H_2O$	1295.05	
37	selenide	$HgSe$	279.81	gr. plates
38	sulfate	$HgSO_4$	296.72	wh. cryst. powd.
39	sulfate, basic	$HgSO_4.2HgO$	729.94	yel.

INORGANIC COMPOUNDS (Continued)

Sp. Gr. $H_2O = 1$ (A) air = 1 (D) $H_2 = 1$	Melting-point, Deg. C.	Boiling-point, Deg. C.	Solubility in 100 parts of		
			Cold water	Hot water	Alcohol, acids, etc.
.....	stable −5–+8	.....	$147.4^{0°}$	$134.5^{28°}$	
2.092	$-7H_2O$, 280	stable −10 to −5	$172^{0°}$	$118^{15°}$	
.....	d.	.....	i.	i.	d. HCl
3.55–.63	d.	.....	0.00047–.0006	i.	i. $(NH_4)_2S$; s. dil. a.
.....	d.	.....	0.0006	i.	i. $(NH_4)_2S$; s. dil. a.
.....	$-3H_2O$, 160 –170	.....	deliq.	v. s.	v. s. al.
.....	d.	.....	i.	.....	i. eth.; v. s. al.
$3.2544^{22°}$	.....	.....	$25^{100°}$	$100^{100°}$	s. al.
.....	.....	.....	sl. s.	.....	s. HCl, HNO_3
.....	d. 130–40	.....	0.17	1.6	s. HNO_3, HCl, $Hg(NO_3)_2$
5.738	235–44	subl. 319–25	$1.06^{9°}$	$20–25^{100°}$	s. al., eth.
.....	.....	.....	i.		
4.998	d.	.....	25		
5.424	282	303–7 subl.	$5.73^{0°}$	$53.96^{100°}$	43.5 al., 33 eth.
.....	d.	.....	sl. s.	dec.	dec. a.
4.018	d.	.....	$12.5^{15°}$	$53^{100°}$	5 al.
.....	.....	.....	dec.		
.....	.....	.....	dec.	.....	s. a.
4.42	expl.	.....	sl. s.	s.	s. al., NH_4OH
.....	$-H_2O$, 175	.....	i.	i.	s. a.
.....	.....	.....	i.	.....	s. NH_4Cl, HCl; i. HNO_3
6.257	253	349	$0.004^{17.5°}$	.....	1.186 $^{18°}$ al.; s. $Na_2S_2O_3$, alk. salts
6.0	241	349	i.	.....	
.....	229	360	.....	.....	s. eth.
.....	153	315	i.	sl. s.	s. al.
.....	d.	.....	v. s.	dec.	s. HNO_3; i. al.
.....	expl.	.....	dec.	.....	dec. a.
.....	d.	.....	i.	i.	s. HCl; sl. s. HNO_3
11.14	d.	.....	$0.00515^{25°}$	$0.0395^{100°}$	s. a.; i. al.
.....	.....	.....	i.	sl. s.	v. s. al.
8.67	.....	.....	i.	dec.	
$4.437^{19°}$	expl.	.....	sl. s.		
.....	d. 100	.....	dec.	.....	s. HNO_3
.....	.....	.....	dec.	.....	s. HI
.....	.....	.....	i.	sl. s.	s. a., NH_4Cl; i. al.
$4.289^{22.5°}$	.....	.....	dec.	.....	s. al., eth., KI
7.1–8.9	subl.	.....	i.	.....	s. aq. reg.
5.466	.....	.....	dec.	.....	s. a.; i. al.
5.44	.....	.....	0.002	.....	s. a.; i. al.

	Name	Formula	Mol. wt.	Crystalline form and color
1	Mercuric sulfide	HgS	232.67	blk. amor.
2	sulfide	HgS	232.67	red rhbdr. or hex.
3	sulfocyanate	$Hg(CNS)_2$	316.75	
4	Mercurous acetate	$HgC_2H_3O_2$	259.63	micaceous scales
5	arsenate	Hg_3AsO_4	740.79	dk. red
6	arsenate, acid	Hg_2HAsO_4	541.19	yel.-red
7	bromate	$HgBrO_3$	328.53	cryst.
8	bromide	$HgBr$	280.53	tetrag. yel.
9	carbonate	Hg_2CO_3	461.22	yel.-br.
10	chlorate	$HgClO_3$	284.07	cryst.
11	chloride (calomel)	$HgCl$	236.07	rhombic or tetrag. wh.
12	chromate	Hg_2CrO_4	517.23	red cryst.
13	fluoride	HgF	219.61	yel. monocl.
14	fluosilicate	$Hg_2SiF_6.2H_2O$	579.31	prism.
15	formate	$HgCHO_2$	245.62	glist. scales
16	iodate	$HgIO_3$	375.54	yellowish
17	iodide	HgI	327.54	yel. tetrag.
18	nitrate	$HgNO_3.2H_2O$	298.65	wh. monocl.
19	oxalate	$Hg_2C_2O_4$	489.22	
20	oxide	Hg_2O	417.22	black
21	phosphate	Hg_3PO_4	696.86	
22	sulfate	Hg_2SO_4	497.28	wh. monocl.
23	sulfide	Hg_2S	433.28	blk.
24	sulfocyanate	$HgCNS$	258.68	
25	trinitride	HgN_3	242.63	cryst.
26	Mercury	Hg	200.61	silvery liq.
27	Mercury-ammonium compounds:			
28	Dimercuri-diammonium chloride (infusible white ppt.)	$NHg_2Cl.NH_4Cl$	504.18	cryst.
29	Dimercuri-tetraammonium chloride (fusible white ppt.)	$NHg_2Cl.3NH_4Cl$	611.18	crystals, red
30	Molybdenum	Mo	96.00	gray
31	bromhydroxide	$Mo_3Br_4(OH)_2$	641.68	red powd.
32	bromide, di-	$MoBr_2$	255.83	yel.
33	bromide, tri-	$MoBr_3$	335.75	dk. grn. need.
34	bromide, tetra-	$MoBr_4$	415.66	blk. need.

INORGANIC COMPOUNDS (Continued)

	Sp. Gr. $H_2O = 1$ (A) air = 1 (D) $H_2 = 1$	Melting-point, Deg. C.	Boiling-point, Deg. C.	Solubility in 100 parts of		
				Cold water	Hot water	Alcohol, acids, etc.
1	7.67	subl. 446	.....	0.0025	i.	s. Na_2S, K_2S;
2	8.09	subl. 446	.....	i.	i.	i. HNO_3; s. aq. reg.
3	.....	d.	.....	sl. s.	s.	s.al., NH_4salts
4	.....	d.	.....	$0.75^{13°}$	.....	s. H_2SO_4, HNO_3
5	.....	d.	.....	i.	.....	s. HNO_3; i. acet. a.
6	.....	d.	.....	i.	.....	s. HNO_3
7	.....	d.	.....	dec.	.....	s. HNO_3, HCl, $HgNO_3$
8	7.307	subl. 405	.....	i.	i.	i. al.; s. a.
9	.....	d. 130	.....	i.	dec.	s. NH_4Cl
10	6.409	d.	.....	s.	dec.	s. al., acet. a.
11	6.482–7.18	subl. 500	382.5	0.00031	0.01	i. al., eth.; s. $Hg(NO_3)_2$, aq. reg.; sl. s. h. HNO_3, HCl
12	.....	d.	.....	sl. s.	s.	s. HNO_3, KCN
13	.....	d. 200	.....	dec.		
14	.....	.....	.....	sl. s.		
15	.....	.....	.....	$0.4^{17°}$	dec.	i. al.
16	.....	.....	.....	i.	i.	s. dil. HCl
17	7.7	290	310	0.0417	.....	s. KI; i. al.
18	4.78	d.	.....	v. s.	dec.	
19	.....	.....	.....	i.	i.	sl. s. HNO_3
20	9.8	d.	.....	i.	i.	s. acet. a.; i. alk.
21	.....	.....	.....	i.	dec.	s. HNO_3
22	7.56	.....	dec.	$0.055^{15.5°}$	$0.092^{100°}$	s. H_2SO_4, HNO_3
23	.....	d. 0°	.....	i.	.....	i. a., $(NH_4)_2S$
24	.....	d.	.....	i.	.....	s. HCl, KCNS
25	.....	expl.	.....	i.		
26	$13.595^{0°}_{4°}$	−38.87	357.25	i.	i.	s. HNO_3, i. HCl
27						
28	5.70	.....	.....	0.14	dec.	s. a.; i. al.
29	.....	300	.....	i.	dec.	s. a., KI
30	9.01	2535	3620	i.	i.	s. HNO_3, H_2SO_4, HCl, aq. reg.
31	.....	.....	.....	.....	.....	s. KOH
32	.....	.....	.....	i.	i.	s. alk.; i. a.
33	.....	d.	.....	i.	i.	i. a.; d. alk
34	.....	d.	volt.	v. s.		

	Name	Formula	Mol. wt.	Crystalline form and color
1	Molybdenum carbide	MoC	108.00	gray pr.
2	chloride, di-	$MoCl_2$	166.91	yel. amor.
3	chloride, tri-	$MoCl_3$	202.37	red need.
4	chloride, tetra-	$MoCl_4$	237.83	br. cryst.
5	chloride, penta-	$MoCl_5$	273.29	blk. cryst.
6	chlorohydroxide	$Mo_2Cl_4(OH)_2.2H_2O$	499.88	yel. amor.
7	hexafluoride	MoF_6	210.00	cryst.
8	oxide, di-	MoO_2	128.00	red pr.
9	oxide, sesqui-	Mo_2O_3	240.00	yel.-blk.
10	oxide, tri-	MoO_3	144.00	rhombic
11	oxybromide	MoO_2Br_2	287.83	yel. cryst.
12	oxychloride	$MoOCl_4$	253.83	green
13	oxychloride	MoO_2Cl_2	198.91	yel. wh.
14	oxychloride	$MoOCl_3$	218.37	green
15	oxychloride	$Mo_2O_3Cl_6$	417.29	dk. br. cryst.
16	phosphide	Mo_3P_2	350.05	gr. cryst.
17	sulfide, di-	MoS_2	160.13	blk. powd.
18	sulfide, tri-	MoS_3	192.19	red.-br.
19	sulfide, tetra-	MoS_4	224.26	brown powd.
20	Molybdic acid	H_2MoO_4	162.02	need. wh.-yel.
21	Molybdic acid	$H_2MoO_4.H_2O$	180.03	monocl. yel.
22	Neodymium	Nd	144.27	yellowish
23	bromate	$Nd_2(BrO_3)_6.18H_2O$	1380.34	red hex. pr.
24	carbide	NdC_2	168.27	yel. hex.
25	chloride	$NdCl_3$	250.64	violet pr.
26	chloride	$NdCl_3.6H_2O$	358.74	red rhombic
27	oxide	Nd_2O_3	336.54	reddish
28	sulfide	Nd_2S_3	384.73	olive grn.
29	Neon	Ne	20.20	colorl. gas.
30	Nickel	Ni	58.69	silvery metal
31	acetate	$Ni(C_2H_3O_2)_2$	176.74	prism. green
32	ammonium chloride	$NiCl_2.NH_4Cl.6H_2O$	291.20	grn. rhombic
33	ammonium sulfate	$NiSO_4.(NH_4)_2SO_4.6H_2O$	394.99	grn. cryst.
34	arsenide	$NiAs$	133.65	
35	arsenite	$Ni_3H_6(AsO_3)_4.H_2O$	691.97	grn.-wh.
36	boride	NiB	69.51	prisms
37	bromate	$Ni(BrO_3)_2.6H_2O$	422.62	monocl.
38	bromide	$NiBr_2$	218.52	yel. scales
39	bromide	$NiBr_2.3H_2O$	272.57	grn. need.
40	bromide ammonia	$NiBr_2.6NH_3$	320.71	violet powd.

INORGANIC COMPOUNDS (Continued)

	Sp. Gr. $H_2O = 1$ (A) air = 1 (D) H_2 = 1	Melting-point, Deg. C.	Boiling-point, Deg. C.	Solubility in 100 parts of		
				Cold water	Hot water	Alcohol, acids, etc.
1	$8.4^{20°}$	d.	.....	i.	i.	s. HNO_3, HF, h. H_2SO_4
2	.....	d.	.....	i.	i.	s. a., al., eth.
3	.....	d.	.....	i.	dec.	s. HNO_3, H_2SO_4, al.
4	.....	.....	.....	deliq.	dec.	s. HNO_3, H_2SO_4, al.
5	9.5	194	268	deliq.	dec.	s. HNO_3, H_2SO_4, al.
6	.....	.....	.....	i.	.....	s. a.; i. al.
7	.....	17	35	sl. s.		
8	$6.44^{100°}$	.....	.....	i.	i.	sl. s. H_2SO_4; i. alk.
9	.....	.....	.....	i.	i.	i. a., alk.
10	$4.39^{21°}$	791	subl.	$0.107^{18°}$	$1.705^{70°}$	s. a., NH_4OH
11	.....	subl.	.....	s.		
12	.....	<100	subl. <100	s.	dec.	
13	.....	subl.	.....	s.	.....	s. al.
14	.....	subl.	.....	deliq.		
15	.....	subl.	.....	deliq.	s.	
16	6.17	d.	.....	i.	.....	s. h. HNO_3
17	$4.80^{14°}$	d.	.....	i.	i.	s. H_2SO_4, aq. reg.
18	.....	d.	.....	sl. s.	s.	s. alk., sulfides
19	.....	d.	.....	i.	i.	s. alk., sulfides
20	.....	.....	.....	sl. s.	.....	s. NH_4OH
21	$3.124^{15°}$	$-H_2O$, 70	.....	$0.133^{18°}$	$2.13^{70°}$	s. a., NH_4OH, NH_4 salts
22	6.9563	840	.....	dec.		
23	.....	66.7	$-18H_2O$, 150	$146^{25°}$		
24	5.515	d.	.....	dec.	dec.	s. dil. a., H_2SO_4
25	$4.134^{\frac{25}{4}°}$	124	.....	$99^{12°}$	$141.2^{100°}$	s. al.; i. eth., chl.
26	$2.282^{\frac{16}{4}°}$	124	$-5H_2O$, 105 $-6H_2O$, 160	$246^{13°}$	$511.6^{100°}$	s. al.
27	.....	.....	.....	i.	.....	s. HCl
28	$5.179^{11°}$	d.	.....	i.	dec.	s. dil. a.
29	(A) 0.695 (D) 9.96	−253	−239			
30	8.60–.93	1452	.....	i.	i.	s. dil. HNO_3; sl. s. HCl, H_2SO_4
31	1.799	dec.	.....	16.6	.....	i. al.
32	1.645	.....	.....	v. s.	v. s.	
33	$1.929^{20°}_{4°}$	.....	.....	$2.5^{3.5°}$	$39.2^{85°}$	sl. s. $(NH_4)_2SO_4$
34	7.663	.....	.....	i.	i.	s. aq. reg.
35	.....	d.	.....	i.	.....	s. alk., a.
36	$7.39^{18°}$	.....	.....	dec.	.....	s. HNO_3
37	2.575	d.	.....	28		
38	$4.64^{\frac{25}{25}°}$	d.	.....	$112.8^{0°}$	$155.1^{100°}$	s. al., eth.
39	.....	$-3H_2O$, 200	.....	$199^{0°}$	$315.7^{100°}$	s. al., eth. NH_4OH
40	1.937	.....	.....	v. s.	dec.	

	Name	Formula	Mol. wt.	Crystalline form and color
1	Nickel carbonate	$NiCO_3$	118.69	rhombic lt. grn.
2	carbonate, basic	$2NiCO_3.3Ni(OH)_2.4H_2O$	587.56	lt. grn.
3	carbonyl	$Ni(CO)_4$	170.69	need. or liq.
4	chloride	$NiCl_2$	129.60	yel. scales
5	chloride	$NiCl_2.6H_2O$	237.70	hex. grn.
6	chloride ammonia	$NiCl_2.6NH_3$	231.80	
7	cyanide	$Ni(CN)_2.4H_2O$	182.77	grn. pl.
8	dimethylglyoxime	$NiC_{14}H_{14}N_4O_4$	360.83	scarlet red cryst.
9	ferrocyanide	$Ni_2Fe(CN)_6.11H_2O$	527.44	grn. wh.
10	fluoride	NiF_2	96.69	grn. quad.
11	fluoride, acid	$NiF_2.5HF.6H_2O$	304.83	trim. prisms
12	fluosilicate	$NiSiF_6.6H_2O$	308.85	grn. rhbdr.
13	formate	$Ni(CHO_2)_2.2H_2O$	184.74	grn. cryst.
14	hydroxide (ic)	$Ni(OH)_3$	109.71	blk.
15	hydroxide (ous)	$4Ni(OH)_2.H_2O$	388.84	lt. grn.
16	iodide	NiI_2	312.55	blk. scales
17	iodide ammonia	$NiI_2.6NH_3$	414.75	
18	nitrate	$Ni(NO_3)_2.6H_2O$	290.80	grn. monocl.
19	nitrate ammonia	$Ni(NO_3)_2.4NH_3.2H_2O$	286.87	
20	oxide, mon-	NiO	74.69	reg. grn.
21	oxide, sesqui-	Ni_2O_3	165.38	blk.
22	oxide (ous) (ic)	Ni_3O_4	240.07	gray
23	oxyiodide	$NiI_2.9NiO.15H_2O$	1255.00	
24	perchlorate	$Ni(ClO_4)_2.5H_2O$	347.68	grn. hex.
25	phosphate	$Ni_3(PO_4)_2.7H_2O$	492.14	grn.
26	phosphide	Ni_2P_2	138.12	dk. grn.
27	phosphide	Ni_2P	148.41	gray cryst.
28	pyrophosphate	$Ni_2P_2O_7.6H_2O$	399.53	grn.
29	potassium cyanide	$Ni(CN)_2.2KCN.H_2O$	258.93	red yel. monocl.
30	selenide	$NiSe$	137.89	cryst.
31	sulfate	$NiSO_4$	154.75	yel. reg.
32	sulfate	$NiSO_4.6H_2O$	262.85	bl. tetrag. or grn. monocl.
33	sulfate	$NiSO_4.7H_2O$	280.87	grn. rhombic or monocl.
34	sulfide, mono-	NiS	90.75	blk. hex.
35	sulfide, sub-	Ni_3S	149.44	yel. cryst.
36	sulfide, (ous) (ic)	Ni_3S_4	304.33	gr.-blk. rhbdr.
37	sulfite	$NiSO_3.6H_2O$	246.85	grn. tetrahdr.
38	Niobium *see columbium*			
39	Nitric acid	HNO_3	63.02	colorl. liq.
40	Nitrogen	N_2	28.02	colorl. gas.

INORGANIC COMPOUNDS (Continued)

	Sp. Gr. $H_2O = 1$ (A) air = 1 (D) H_2 = 1	Melting-point, Deg. C.	Boiling-point, Deg. C.	Solubility in 100 parts of		
				Cold water	Hot water	Alcohol, acids, etc.
1	.....	d.	.....	i.	i.	s. a.
2	.....	d.	.....	i.	dec.	s. a., NH_4 salts
3	$1.3185^{17°}$	−25	43	$0.018^{9.8°}$	i.	s. al. chl., HNO_3
4	2.56	subl.	.....	$53.8^{0°}$	$87.6^{100°}$	s. al., NH_4OH
5	.....	.....	.....	$179.3^{0°}$	$599^{100°}$	v. s. al.
6	.....	.....	.....	s.	dec.	i. al.; s. NH_4OH
7	.....	$-4H_2O$, 200	d.	i.	i.	s. KCN; i. dil. KCl
8	.....	subl. 250	.....	i	i.	s. abs. al., a.; i. acet. a., NH_4OH
9	.....	.....	.....	i.	.....	i. HCl; s. NH_4OH
10	$2.855^{14°}$	.....	.....	0.02	.....	i. a., al., eth
11	2.132					
12	2.109	d.	.....	v. s.		
13	2.1547	d.	.....	s.		
14	.....	d.	.....	i.	i.	s. a., NH_4OH
15	4.36	d.	.....	i.	i.	s. a., NH_4OH
16	.....	subl.	.....	$124.2^{0°}$	$188.2^{100°}$	s. al.
17	2.101	d.	.....	dec.	.....	s. NH_4OH
18	$2.065^{14°}$	56.7	136.7	$238.5^{0°}$	∞	s. al., NH_4OH
19	.....	.....	.....	v. s.	.....	i. al.
20	6.69	to Ni_2O_3, 400	.....	i.	i.	s. a., NH_4OH
21	$4.84^{18°}$	to NiO, 600	.....	i.	i.	s. HCl, NH_4OH
22	.....	.....	.....	i.	i.	s. a.
23	.....	.....	.....	i.	.....	s. HNO_3; i. NH_4OH
24	.....	149	.....	$222.5^{0°}$	$273.7^{45°}$	s. al.; i. chl.
25	.....	.....	.....	i.	i.	s. a., NH_4 salts
26	5.99	.....	.....	i.	i.	i. HCl
27	$6.3^{15°}$	.....	.....	i.	.....	i. a.; s. HNO_3 + HF
28	anh. 3.9303$^{25°}$	.....	.....	i.	.....	s. a., NH_4OH
29	$1.875^{11°}$	$-H_2O$, 100	.....	s	.....	d. a.
30	8.46	.....	.....	i.	.....	s. HNO_3, aq. reg.
31	3.418^{15C}	$-SO_2$, 840	.....	$29.3^{0°}$	$83.7^{100°}$	i. al., eth.
32	2.031	$-6H_2O$, 280	.....	$62.52^{0°}$	$340.7^{100°}$	v. s. al., NH_4OH
33	1.98	98–100	$-6H_2O$, 103	$75.6^{15.5°}$	$475.8^{100°}$	s. al.
34	4.60	797	.....	0.00036	dec.	s. HNO_3, aq. reg.
35	5.52	.....	.....	i.	.....	s. HNO_3
36	.....	.....	.....	i.	.....	s. HNO_3
37	.....	.....	.....	i.	.....	s. HCl, H_2SO_3
38						
39	$1.53^{t°}_{0}$	−41.3	86	∞	∞	
40	(A) 0.96737	−211	−195	2.348 c.c.$^{0°}$	1.542 c.c.$^{20°}$	sl. s. al.

	Name	Formula	Mol. wt.	Crystalline form and color
1	Nitrogen bromophosphide	$NPBr_2$	204.87	
2	chloride	NCl_2	120.38	yel. oil
3	chlorophosphide	$N_3P_3Cl_6$	347.85	trim
4	iodide	NI_3	394.80	blk
5	iodoazoimide	NH_3NI_2	411.84	red ortho rhomb.
6	oxide, mon- (ous)	N_2O	44.02	colorl. gas
7	oxide, di- (ic)	NO or (N_2O_2)	30.01 (60.02)	colorl. gas
8	oxide, tri-	N_2O_3	76.02	bl. solid or liq., red gas.
9	oxide, tetra-	NO_2 or (N_2O_4)	46.01 (92.02)	colorl. solid, yel. li red br. gas
10	oxide, pent-	N_2O_5	108.02	rhombic wh
11	oxybromide (nitrosyl bromide)	NOBr	109.92	dk. br. liq
12	oxychloride (nitrosyl chloride)	NOCl	65.47	yel.-red cryst., li or gas
13	selenide	NSe	93.21	orange yel
14	sulfide	N_4S_4	184.29	orange red monocl.
15	sulfide, penta-	N_2S_5	188.34	red
16	sulfochloride	NS_2Cl	145.66	yel
17	Nitroxyl fluoride	NO_2F	65.01	gas
18	Osmium	Os	190.80	bl. amor
19	ammonium tri-chloride	$2(OsCl_3.2NH_4Cl).3H_2O$	862.38	red br. cryst
20	chloride, di-	$OsCl_2$	261.71	grn. need
21	chloride, tri-	$OsCl_3$	297.17	reg. br
22	chloride, tri-	$OsCl_3.3H_2O$	351.22	
23	chloride, tetra-	$OsCl_4$	332.63	red-yel. need
24	oxide, mon-	OsO	206.80	blk
25	oxide, di-	OsO_2	222.80	copper red
26	oxide, sesqui-	Os_2O_3	429.60	blk
27	oxide, tetra-	OsO_4	254.80	colorl. monocl.
28	potassium tri-chloride	$2(OsCl_3.3KCl).6H_2O$	1149.7	6dk. red cryst
29	potassium tetra-chloride	$OsCl_4.2KCl$	481.73	octahdr. red
30	sulfide, di-	OsS_2	254.93	br. yel
31	sulfide, tetra-	OsS_4	319.06	br. blk
32	sulfite	$OsSO_3$	270.86	bl. blk

INORGANIC COMPOUNDS (Continued)

	Sp. Gr. $H_2O = 1$ (A) air = 1 (D) H_2 = 1	Melting-point, Deg. C.	Boiling-point, Deg. C.	Solubility in 100 parts of		
				Cold water	Hot water	Alcohol, acids, etc.
1	.....	.....	.....	i.	.....	s. eth., chl., CS_2
2	1.653	expl. 95	.....	s.	dec.	s. chl., CS_2, PCl_3
3	1.98	114	255	dec.	.....	s. al., eth., chl.
4	.....	expl.	.....	sl. s. d.		
5	3.5	expl.	.....	dec.	expl.	s. HCl., KCN, $Na_2S_2O_3$; i. abs. al.
6	(A) 1.530	−102.3	−89.4	130.52 c.c.$^{0°}$	60.82 c.c.$^{24°}$	s. al., H_2SO_4
7	(A) 1.0366	−160.6	−153	7.3 c.c.$^{0°}$	0.0$^{100°}$	3.5 c.c. H_2SO_4, 26.6 c.c. al.; s. $FeSO_4$
8	$1.447^{-2\,0}$	−111	3.5	s.	.....	s. a., eth.
9	$1.4903^{2°}_{4°}$	−9.6	21.6	s.	.....	s. CS_2, chl., HNO_3, H_2SO_4
10	$1.642^{18°}$	29.5	45–50	s.		
11	>1.0	−2	.....	dec.	dec.	
12	(A) 2.31 $1.4165^{-12°}$	−60	−5.6	dec.		
13	.....	expl.	.....	i.	.....	s. HNO_3, CS_2
14	$2.22^{15°}$	188	subl. 135	i.	dec.	s. al., eth., CS_2
15	$1.901^{18°}_{4°}$	10–11	d.	i.	.....	sl. s. al., CS_2
16	.....	d.	.....	s.	dec.	s. CS_2
17	(A) 2.24	−139	−63.5	dec.		
18	22.48	2700 (?)	.....	i.	i.	sl. s. HNO_3, aq. reg.
19	.....	.....	.....	v. s.	dec.	v. s. al.; i. eth.
20	.....	.....	.....	i.	.....	s. al., eth., NaCl
21	.....	d. 560–600	.....	sl. s.	.....	s. alk., al., HCl; sl. s. eth.
22	.....	.....	.....	sl. s.	.....	s. alk., HCl
23	.....	.....	.....	sl. s.	.....	s. HCl, al.
24	.....	.....	.....	i.	i.	i. a.
25	.....	.....	.....	i.	i.	i. a.
26	.....	.....	.....	i.	i.	i. a.
27	8.89	20	100	v. s.	v. s.	s. al. eth. NH_4OH
28	.....	$-6H_2O$, 150–180	.....	v. s.	.....	v. s. al.; i. eth.
29	.....	d.	.....	sl. s.	.....	i. al., HCl
30	.....	.....	.....	sl. s.	.....	i. alk.
31	.....	d.	.....	i.	.....	s. HNO_3; i. alk.
32	.....	.....	.....	i.	.....	s. HCl

	Name	Formula	Mol. wt.	Crystalline form and color
1	Oxalic acid	$H_2C_2O_4.2H_2O$	126.05	colorl. cryst.
2	Oxygen	O_2	32.00	colorl. gas
3	Ozone	O_3	48.00	colorl. gas
4	Palladium	Pd	106.70	reg. hex. silvery
5	bromide	$PdBr_2$	266.53	br.
6	chloride	$PdCl_2$	177.61	octahdr. reg.
7	chloride	$PdCl_2.2H_2O$	213.65	br. prism
8	cyanide	$Pd(CN)_2$	158.72	yel.
9	fluoride	PdF_2	144.70	br.
10	hydride	Pd_2H	214.41	
11	hydroxide	$Pd(OH)_2$	140.72	br.
12	iodide	PdI_2	360.56	blk.
13	nitrate	$Pd(NO_3)_2$	230.72	yel.-br. rhombic
14	oxide, sub-	Pd_2O	229.40	blk.
15	oxide, mon-	PdO	122.70	blk.
16	oxide, di-	PdO_2	138.70	blk.
17	sulfate	$PdSO_4.2H_2O$	238.80	br. cryst.
18	sulfide, sub-	Pd_2S	245.46	gray
19	sulfide, mono-	PdS	138.76	blk.
20	sulfide, di-	PdS_2	170.83	dk. br.
21	Palladous diammonium chloride	$PdCl_2.2NH_3$	211.68	red or yel. cryst.
22	diammonium hydroxide	$Pd(OH)_2.2NH_3$	174.78	cryst.
23	Perchloric acid	$HClO_4$	100.48	colorl. oily liq.
24	Perchloric acid	$HClO_4.H_2O$	118.50	need.
25	Perchloric acid	$HClO_4.2H_2O$	136.51	cryst. or liq.
26	Periodic acid	$HIO_4.2H_2O$	227.97	monocl.
27	Permanganic acid	$HMnO_4$	119.94	
28	Permolybdic acid	$HMoO_4.2H_2O$	197.04	wh. cryst.
29	Phosgene *see carbon oxychloride*			
30	Phosphamic acid	$PONH_2.(OH)_2$	97.07	
31	Phosphine	PH_3	34.05	gas
32	Phosphine liquid	P_2H_4	66.09	liq.
33	Phosphine solid	$(P_4H_2)_3$	378.37	yel.
34	Phosphomolybdic acid	$H_3PO_4.12MoO_3.12H_2O$	2042.24	monocl. yel.
35	Phosphonium bromide	PH_4Br	114.98	reg. colorl. or gas
36	chloride	PH_4Cl	70.52	reg.
37	iodide	PH_4I	161.99	tetrag. prisms
38	sulfate	$(PH_4)_2SO_4$	166.18	cryst.
39	Phosphoric acid, hypo-	$H_4P_2O_6$	162.09	cryst.
41	Phosphoric acid, meta-	HPO_3	80.04	vitreous

INORGANIC COMPOUNDS (Continued)

	Sp. Gr. $H_2O = 1$ (A) air = 1 (D) $H_2 = 1$	Melting-point, Deg. C.	Boiling-point, Deg. C.	Solubility in 100 parts of		
				Cold water	Hot water	Alcohol, acids, etc.
1	$1.653^{18.5°}$	98	.....	$4.90^{0°}$	$120^{70°}$	s. al.
2	(A) 1.1053	−227	−182.7	4.89 c.c.$^{0°}$	2.61 c.c.$^{30°}$ 1.7 c.c.$^{100°}$	sl. s. al.; s. fus. Ag
3	(A) 1.658	d. 270	−119	0.88	.....	s. oil turp., oil cinn.
4	12.16	1550	.....	i.	i.	s. aq. reg.
5	.....	.....	.....	i.	i.	s. HBr
6	.....	501	.....	s.	s.	s. HCl
7	.....	.....	.....	s.	s.	s. HCl
8	.....	d.	.....	i.	i.	s. KCN, NH_4OH
9	.....	.....	.....	sl. s.	.....	s. HF
10	11.06	d.				
11	.....	.....	.....	i.	i.	s. a., alk.
12	.....	100	360	i.	i.	s. ex. KI; i. al., eth.
13	.....	d.	.....	s.	dec.	s. HNO_3
14	.....	d.	.....	i.	.....	i. a.
15	.....	−O, 875	.....	i.	i.	sl. s. a.
16	.....	−O, 200	.....	i.	i.	sl. s. a.
17	.....	.....	.....	v. s.	dec.	
18	$7.303^{15°}$	.....	.....	i.	.....	i. a.; s. aq. reg.
19	.....	d.	.....	i.	i.	s. HCl; i. $(NH_4)_2S$
20	.....	d.	.....	i.	i.	s. aq. reg.
21	.....	.....	.....	sl. s.	.....	s. a., NH_4OH
22	.....	d. <100	.....	s.	dec.	
23	$1.764^{23°}_{4°}$	.....	39	s.		
24	$1.7756^{20°}_{4°}$	50	d.	s.		
25	1.65	−20.6	200	v. s.	.....	s. al.
26	.....	130	734	v. s.	v. s.	s. al., eth.
27	.....	.....	.....	v. s.	dec.	
28	.....	.....	.....	v. s.	v. s.	
29						
30	.....	d.	.....	v. s.		
31	(A) 1.185	−133.5	−85	sl. s.	i.	s. al., eth., Cu_2Cl_2
32	1.007–.016	<−10	57–8	i.		s. al., turp.
33	1.83	ign. 200	.....	i.	i.	i. al.; s. P, P_2H_4
34	.....	$-H_2O$, 104	.....	s.		
35	(A) 1.906	.....	30 d.	dec.	dec.	
36	.....	26	subl.	dec.		
37	2.86	.....	80	dec.	.....	d. al.
38	.....	.....	.....	dec.		
39	.....	55	d. 70	s.		
40	2.2–.5	subl.	.....	s.	s.	

PHYSICAL CONSTANTS OF

	Name	Formula	Mol. wt.	Crystalline form and color
1	Phosphoric acid, ortho-	H_3PO_4	98.05	rhombic
2	Phosphoric acid, pyro-	$H_4P_2O_7$	178.09	need
3	Phosphorous acid, hypo-	H_3PO_2	66.05	tabl
4	Phosphorous acid, ortho-	H_3PO_3	82.05	yel. cryst
5	Phosphorous acid, pyro-	$H_4P_2O_5$	146.09	need
6	Phosphorus, red	P_4	124.11	red amor
7	Phosphorus, yellow	P_4	124.11	reg. yel
8	Phosphorus, black	P_4	124.11	rhbdr
9	Phosphorus arsenide	PAs	105.99	
10	Phosphorus bromide, tri-	PBr_3	270.78	colorl. fum. liq
11	bromide, penta-	PBr_5	430.61	yel. cryst
12	bromofluoride	PBr_2F_3	247.86	pa. yel
13	bromonitride	PBr_2N	204.87	
14	bromotrichloride, di-	PBr_2Cl_3	297.23	orange cryst
15	bromotrichloride, octa-	PBr_8Cl_3	776.73	br. need
16	bromotrichloride, tetra-	PBr_4Cl_3	457.06	dk. red cryst
17	chloride, tri-	PCl_3	137.40	colorl. liq
18	chloride, penta-	PCl_5	208.31	yel. rhombic
19	chlorofluoride	PCl_2F_3	158.94	
20	fluoride, tri-	PF_3	88.03	gas
21	fluoride, penta-	PF_5	126.03	gas
22	heptabromide dichloride	PBr_7Cl_2	661.35	prisms
23	hydride *see phosphine*			
24	iodide, di-	P_2I_4	569.78	orange pr
25	iodide, tri-	PI_3	411.82	red prisms
26	iodochloride	PI_2Cl_3	391.26	red hex
27	monobromotetrachloride	$PBrCl_4$	252.77	yel. cryst
28	nitride	P_3N_5	163.12	amor
29	oxide, tri-	P_2O_3	110.05	liq. or monocl
30	oxide, tetra-	P_2O_4	126.05	ortho rhomb
31	oxide, penta-	P_2O_5	142.05	amor. wh
32	oxybromide	$POBr_3$	286.78	plates
33	oxybromdichloride	$POBrCl_2$	197.86	tabl
34	oxychloride	$POCl_3$	153.40	tabl. or liq
35	oxyfluoride	POF_3	104.03	gas

INORGANIC COMPOUNDS (Continued)

	Sp. Gr. $H_2O = 1$ (A) air = 1 (D) $H_2 = 1$	Melting-point, Deg. C.	Boiling-point, Deg. C.	Solubility in 100 parts of		
				Cold water	Hot water	Alcohol, acids, etc.
1	$1.884^{18°}$	38.6	$-\frac{1}{2}H_2O$, 213	v. s.	v. s.	s. al.
2	.....	61	.....	v. s.	dec.	v. s. al., eth.
3	$1.493^{18.8°}$	26.5	d.	∞	∞	
4	$1.651^{21.2°}$	70.1	d. 200	∞	∞	
5	.....	38	d. 130	dec.		
6	2.20	725, ign. in air	.....	i.	i.	i. eth., CS_2; s. alk.
7	$1.83^{18°}$	44.2	290	0.00033	sl. s.	1000 CS_2; 0.4 al.; $1.5^{90°}$, $10^{81°}$ bz.
8	2.34	.....	.....	i.	i.	i. CS_2
9	.....	.....	subl. d.	dec.	.....	i. al., eth.; s. CS_2
10	2.8847	−41.5	175.3	dec.		s. CS_2, eth., chl.
11	.....	<100	106 d.	dec.		
12	.....	−20	.....	dec.		
13	.....	188–90	.....	.....	.....	s. eth., CS_2 chl.
14	.....	35				
15	.....	25				
16	.....	.....	.....	dec.		
17	$1.61282^{0°}_{4°}$	−111.8	75.95	dec.	dec.	s. CS_2, eth., chl.
18	(D) $3.60^{296°}$	148, under press.	subl. 160	dec.	.....	s. CS_2, C_6H_5COCl
19	.....	−8	d. 250	dec.	.....	s. al.
20	.....	−160	−95	dec.	.....	s. al., alk.
21	(D) 4.30	−83	−75	dec.		
22	.....	.....	.....	dec.	.....	s. PCl_3
23						
24	.....	110	.....	dec.	.....	s. CS_2
25	.....	61	d.	dec.	dec.	s. CS_2
26	.....	.....	.....	dec.	.....	s. CS_2
27	.....	.....	.....	dec.		
28	$2.51^{18°}$	d.	.....	i.	s. d.	
29	$2.135^{21°}_{4°}$	22.5	173	s.	dec.	s. CS_2 eth., chl.
30	$2.537^{23.4°}$	>100	180	s.		s. H_2SO_4
31	2.387	800	subl.	v. s.	v. s.	s. H_2SO_4
32	2.822	55.5	189.5	dec.	.....	s. eth., CS_2, H_2SO_4
33	$2.049^{0°}_{4°}$	13	137.6	dec.		
34	$1.712^{0°}_{4°}$	1.25	107.2	dec.	.....	d. al.
35	.....	−68	−40	dec.	.....	d. al.

PHYSICAL CONSTANTS OF

	Name	Formula	Mol. wt.	Crystalline form and color
1	Phosphorus oxyio- dide	$P_3O_8I_6$	982.67	red cryst.
2	oxynitride	PON	61.04	amor.
3	selenide, sub-	P_4Se	203.31	dk. yel.
4	selenide, mono-	P_2Se	141.25	red.
5	selenide, tri-	P_2Se_3	299.65	dk. red.
6	selenide, penta-	P_2Se_5	458.05	dk. red need.
7	sulfide, sesqui-	P_4S_3	220.30	rhombic yel.
8	sulfide, di-	P_3S_8	285.47	yel. need.
9	sulfide, tri-	P_4S_6	316.49	gray-yel. cryst.
10	sulfide, penta-	P_2S_5	222.37	yel. cryst.
11	sulfobromchloride	$PSBrCl_2$	213.92	yel. liq.
12	sulfobromide	$PSBr_3$	302.84	yel. octahdr.
13	sulfobromide	$PSBr_3.H_2O$	320.86	yel. cryst.
14	sulfochloride	$PSCl_3$	169.46	liq.
15	sulfocyanate	$P(CNS)_3$	205.24	liq.
16	sulfofluoride	PSF_3	120.09	gas.
17	sulfoxide	$P_4S_4O_6$	348.36	tetrag.
18	thioamide	$PS(NH_2)_3$	111.16	amor. yel.
19	trioxytetrachloride	$P_2O_3Cl_4$	251.88	
20	trisulfotetra- bromide	$P_2S_3Br_4$	477.91	yel. oil
21	Phosphotungstic acid	$P_2O_5.12WO_3.42H_2O$	3682.73	yel.-grn. cryst.
22	Platinic acid, brom-	$H_2PtBr_6.9H_2O$	838.89	monocl. red
23	Platinic acid, chlor-	$H_2PtCl_6.6H_2O$	518.08	red.-br. cryst.
24	Platinic acid, iodo-	$H_2PtI_6.9H_2O$	1120.98	br. monocl.
25	Platino-platinic oxide	Pt_3O_4	649.69	blk.
26	Platinum	Pt	195.23	silvery-gray
27	bromide di- (ous)	$PtBr_2$	355.06	br.
28	bromide, tetra- (ic)	$PtBr_4$	514.89	dk. br.
29	chloride, di- (ous)	$PtCl_2$	266.14	br.
30	chloride, tetra- (ic)	$PtCl_4$	337.06	br.
31	chloride, tetra- (ic)	$PtCl_4.5H_2O$	427.14	red monocl.
32	cyanide	$Pt(CN)_2$	247.25	yel. br.
33	fluoride	PtF_4	271.23	lt. br. cryst.
34	hydroxide (ous)	$Pt(OH)_2$	229.25	blk.
35	hydroxide (ous)	$Pt(OH)_2.2H_2O$	265.28	yel.
36	hydroxide (ic)	$Pt(OH)_4$	263.26	red br.
37	iodide, di-(ous)	PtI_2	449.09	blk.
38	iodide, tetra- (ic)	PtI_4	702.96	amor. br. -blk.
39	oxide, mon- (ous)	PtO	211.23	violet-blk.
40	oxide, di- (ic)	PtO_2	227.23	blk.

INORGANIC COMPOUNDS (Continued)

	Sp. Gr. $H_2O = 1$ (A) air = 1 (D) $H_2 = 1$	Melting-point, Deg. C.	Boiling-point, Deg. C.	Solubility in 100 parts of		
				Cold water	Hot water	Alcohol, acids, etc.
1	.....	140	d.	s.	.....	s. al. eth.
2	.....	.....	.....	i.	.....	i. a., alk.
3	.....	−12	ign.	dec.	.....	s. CS_2; i. al., eth.
4	.....	.....	.....	dec.	.....	sl. s. CS_2; i. al., eth.
5	.....	.....	.....	.....	dec.	s. KOH; i. CS_2
6	.....	.....	.....	dec.	.....	s. CCl_4; i. CS_2
7	$2.0^{11°}$	172	407.8	i.	dec.	s. CS_2, PCl_3
8	.....	297	$337^{10.5mm.}$	.....	.....	sl s. CS_2
9	.....	290	490	dec.	.....	s. al., eth., alk.
10	$2.09^{17°}$	275	530	dec.	.....	s. CS_2, alk.
11	$2.12^{9°}$	−30	150	dec.		
12	$2.85^{17°}$	36–8	d.	dec.	.....	s. CS_2, eth., PCl_3, PBr_3
13	$2.794^{18°}$	35				
14	$1.634^{22°}$	−35	125	dec.	.....	s. CS_2
15	$1.625^{18°}$	<−20	265	dec.	.....	s. al., eth., CS_2, chl
16	.....	.....	3.87^{5} atm.	dec.	.....	sl. s. eth.; i. CS_2
17	.....	102	295	dec.	.....	50 CS_2
18	$1.7^{13°}$	d. 200	.....	sl. s.	dec.	
19	$1.78^{7°}$	.....	210–15	dec.		
20	$2.262^{17°}$	.....	d.			
21	.....	.....	.....	s.	.....	s. al , eth.
22	.....	d. 100	.....	v. s.	v. s.	v. s. al., eth., chl.
23	2.431	d.	.....	v. s.	v. s.	s. al., eth.
24	.....	.....	.....	s. d.		
25	.....	d.	.....	i.	.....	i. a.
26	$21.37^{20°}$	1755	3910	i.	i.	s. aq. reg., fus. alk.
27	.....	d. 300	.....	i.	i.	s. HBr, KBr
28	.....	.....	.....	$0.41^{20°}$	sl. s.	s. al., eth., HBr
29	$5.87^{11°}$	d.	.....	i.	i.	s. HCl, NH_4OH
30	.....	d.	.....	v. s.	v. s.	s. al., eth.
31	2.43	$-4H_2O$, 100	.....	v. s.	v. s.	s. al., eth.
32	.....	.....	.....	i.	i.	i. alk.
33	.....	d.	.....	s. d.		
34	.....	d.	.....	i.	i.	s. HCl, HBr, alk.
35	.....	$-2H_2O$, 100	.....	i.	i.	s. a., alk.
36	.....	d.	.....	i.	i.	v. s. alk., a.
37	.....	d. 325	.....	i.	i.	i. a., s. Na_2SO_3
38	.....	.....	.....	i.	.....	s. alk., HI, KI
39	.....	555	.....	i.	i.	s. H_2SO_3, HCl
40	.....	430	.....	i.	i.	i. a.

	Name	Formula	Mol. wt.	Crystalline form and color
1	Platinum oxide, di- (ic)	$PtO_2.H_2O$	245.25	yel.
2	oxide, di- (ic)	$PtO_2.2H_2O$	263.26	br.
3	oxide, di- (ic)	$PtO_2.3H_2O$	281.28	blk.
4	oxide, di- (ic)	$PtO_2.4H_2O$	299.29	yel. need.
5	sulfide, mono- (ous)	PtS	227.29	blk.
6	sulfide, di- (ic)	PtS_2	259.36	need. blk. or gray
7	sulfide, sesqui-	Pt_2S_3	486.65	gray
8	sulfate	$Pt(SO_4)_2.4H_2O$	459.42	yel. pl.
9	Potassium	K	39.10	silvery tetrag.
10	actate	$KC_2H_3O_2$	98.12	wh. powd.
11	acetate, acid	$KH(C_2H_3O_2)_2$	158.14	need. or pl.
12	aluminate	$K_2Al_2O_4.3H_2O$	250.18	cryst.
13	amid	KH_2N	55.12	yel. grn.
14	antimonate	$KSbO_3$	208.87	cryst.
15	antimonyl tartrate	$KSbOC_4H_4O_6.\frac{1}{2}H_2O$	333.91	octahdr.
16	arsenate (tribasic)	K_3AsO_4	256.25	cryst.
17	arsenate (dibasic)	K_2HAsO_4	218.16	cryst.
18	arsenate (mono- basic)	KH_2AsO_4	180.07	colorl. cryst.
19	arsenite	$KAsO_2$	146.06	
20	arsenite, acid	$KH(AsO_2)_2.H_2O$	272.04	
21	aurate	$KAuO_2.3H_2O$	322.34	
22	auricyanide	$KAu(CN)_4.1\frac{1}{2}H_2O$	367.35	tabl.
23	aurocyanide	$KAu(CN)_2$	288.31	rhombic octahdr.
24	benzoate	$KC_7H_5O_2.3H_2O$	214.18	wh. cryst powd.
25	borate, meta-	KB_2O_4	163.83	hex. prisms.
26	borate, tetra-	$K_2B_4O_7.5H_2O$	323.55	hex. prisms, wh.
27	borofluoride	KBF_4	125.92	hex.
28	borotartrate	$KC_4H_4BO_7$	213.95	wh. cryst.
29	bromate	$KBrO_3$	167.01	rhbdr.
30	bromide	KBr	119.01	reg. colorl.
31	bromaurate	$KAuBr_4$	555.96	monocl.
32	bromaurate	$KAuBr_4.2H_2O$	591.99	
33	bromoplatinate	K_2PtBr_6	752.92	reg. red.
34	bromoplatinite	K_2PtBr_4	593.09	rhbdr. br.
35	carbonate	K_2CO_3	138.19	wh. powd.
36	carbonate	$K_2CO_3.2H_2O$	174.23	rhombic
37	carbonate	$2K_2CO_3.3H_2O$	330.43	monocl.
38	carbonate, acid	$KHCO_3$	100.10	moncl.
39	chlorate	$KClO_3$	122.55	monocl.
40	chloride	KCl	74.55	reg.
41	chloraurate	$KAuCl_4$	378.12	yel. need.
42	chlorochromate	$KOClCrO_2$	174.56	red prisms
43	chloriridate	K_2IrCl_6	484.03	blk. octahdr.
44	chloropalladate	K_2PdCl_6	397.63	red. reg.
45	chloropalladite	K_2PdCl_4	326.72	reg. yel.

INORGANIC COMPOUNDS (Continued)

	Sp. Gr. $H_2O = 1$ (A) air = 1 (D) H_2 = 1	Melting-point, Deg. C.	Boiling-point, Deg. C.	Solubility in 100 parts of		
				Cold water	Hot water	Alcohol, acids, etc.
1	.....	$-H_2O$, 100	.....	i.	.....	s. HCl, NaOH; i. acet. a.
2	.....	$-H_2O$, 100	.....	i.		
3	.....	d. 300	.....	i.	i.	i. HCl, aq. reg.
4	.....	d.	.....	i.	i.	s. a.
5	8.897	d.	.....	i.	i.	i. a.; s. $(NH_4)_2S$
6	5.27	d.	.....	i.	i.	s. $(NH_4)_2S$, aq. reg.
7	5.52	.....	.....	i.	.....	i. a.; s. aq. reg
8	.....	.....	.....	s.	dec.	s. a., al., eth.
9	$0.870^{20°}$	62.3	760	dec.	dec.	s. a., al., Hg
10	.....	292	.....	$188^{5°}$	$492^{262°}$	33 al.; i. eth.
11	.....	148	d. 200	dec.	.....	s. acet. a.
12	.....	.....	.....	v. s.	v. s.	i. al.; s. alk.
13	.....	270–2	subl. 400	dec.	.....	d. al.
14	.....	.....	.....	i.	sl. s.	s. h. KOH
15	2.6	$-\frac{1}{2}H_2O$, 100	.....	$5^{8°}$	$52^{100°}$	i. al.
16	.....	.....	.....	18.87	v. s.	4 al.
17	.....	.....	.....	s.		
18	2.851	288	.....	$19^{6°}$	v. s.	i. al.
19	.....	.....	.....	s.	.....	sl. s. al.
20	.....	.....	.....	s.	.....	sl. s. al.
21	.....	.....	.....	v. s.	dec.	s. al.
22	.....	d. 200	.....	s.	v. s.	s. al.
23	.....	.....	.....	14.3	200	sl. s. al.; i. eth.
24	.....	.....	d.	$124.1^{17.5°}$	$161^{5°}$	s. al.
25	.....	947	.....	$71^{30°}$	v. s.	
26	(anh.) 1.74	d.	.....	$26.7^{20°}$	v. s.	
27	$2.498^{20°}$	.....	d.	1.42	$6.25^{100°}$	s. alk.; i. al.
28	1.832	.....	.....	sl. s.		
29	3.24	424	d.	$3.1^{0°}$	$49.75^{100°}$	i.
30	2.75	730	1435	$53.48^{0°}$	$102.04^{180°}$	sl. s. al., eth.
31	.....	d.	.....	sl. s.	.....	s. al.
32	.....	.....	.....	$19.5^{15°}$	$204^{87°}$	s. KBr; d. eth.
33	$4.658\frac{4°}{4°}$	.....	.....	$2.07^{10°}$	$10^{100°}$	
34	.....	.....	.....	v. s.	v. s.	
35	$2.33^{17°}$	909	d.	$89.4^{0°}$	$156^{100°}$	i. al.
36	2.043	.....	.....	$146.9^{0°}$	$331^{100°}$	
37	.....	.....	.....	$129.4^{0°}$	$268.3^{100°}$	
38	2.17	d. 100–200	.....	$22.4^{0°}$	$60^{60°}$	i. al.; s. K_2CO_3
39	$2.344^{17°}$	357	d. 400	$3.3^{0°}$	$56^{100°}$	0.83 al.; s. alk.
40	$1.984\frac{3°}{4°}$	772	1500 subl.	$28.5^{0°}$	$56.6^{100°}$	s. al., alk.
41	.....	.....	.....	$27.7^{10°}$	$80.2^{60°}$	s. al.
42	2.497	.....	.....	s. d.	.....	s. a.
43	3.546	d.	.....	$1.25^{19°}$	6.67	i. al., KCl
44	2.7–.8	d.	.....	sl. s.	dec.	sl. s. HCl; i. al.
45	2.738	d.	.....	s.	v. s.	i. al.; s. KCl, NH_4OH

	Name	Formula	Mol. wt.	Crystalline form and color
1	Potassium chloroplatinate	K_2PtCl_6	486.16	reg. yel.
2	chloroplatinite	K_2PtCl_4	415.25	tetrag. red
3	chlororhodite	$K_3RhCl_6.3H_2O$	486.99	tricl. red
4	chlorostannate	K_2SnCl_6	409.54	
5	chromate	K_2CrO_4	194.11	rhombic yel.
6	citrate	$K_3C_6H_5O_7.H_2O$	324.34	colorl. cryst.
7	cobalticyanide	$K_3Co(CN)_6$	332.28	rhombic yel.
8	cobaltinitrite	$2Co(NO_2)_3.6KNO_2.3H_2O$	958.60	tetrag yel.
9	cobaltocyanide	$K_4Co(CN)_6$	371.37	violet
10	cobaltosulfate	$K_2SO_4.CoSO_4.6H_2O$	437.36	monocl. pl.
11	cyanate	KCNO	81.10	wh. cryst.
12	cyanide	KCN	65.10	reg. wh.
13	dichromate	$K_2Cr_2O_7$	294.21	tricl. or monocl. red
14	ferricyanide	$K_3Fe(CN)_6$	329.18	monocl. red
15	ferric oxalate	$KFe(C_2O_4)_2.2\frac{1}{2}H_2O$	315.98	olive br. cryst.
16	ferric oxalate	$K_3Fe(C_2O_4)_3.3H_2O$	491.18	
17	ferrocyanide	$K_4Fe(CN)_6.3H_2O$	422.32	monocl. yel.
18	fluoride	KF	58.10	
19	fluoride	$KF.2H_2O$	94.13	monocl. pr.
20	fluoride, acid	KHF_2	78.10	reg.
21	fluogermanate	K_2GeF_4	226.79	
22	fluosilicate	K_2SiF_6	220.25	hex.
23	fluostannate	$K_2SnF_6.H_2O$	328.91	octahdr.
24	fluotitanate	$K_2TiF_6.H_2O$	258.31	
25	fluozirconate	K_2ZrF_6	283.19	rhombic
26	formate	$KCHO_2$	84.10	rhombic
27	hydride	KH	40.10	cryst.
28	hydrosulfide	KHS	72.17	yel. rhbdr.
29	hydroxide	KOH	56.10	rhbdr. wh.
30	hypochlorite	KClO	90.55	need.
31	hypophosphite	KH_2PO_2	104.14	hex
32	iodate	KIO_3	214.03	reg.
33	iodate, acid	$KH(IO_3)_2$	389.97	rhombic or monocl.
34	iodide	KI	166.03	reg. wh.
35	iodide, tri-	KI_3	419.89	dk. bl. need.
36	iodobromide	KBr.IBr	325.86	
37	iodochloride	$KCl.ICl_3$	307.86	yel. rhomb.
38	iodoiridite	K_3IrI_6	1071.98	grn. cryst.
39	magnesium chloride (carnallite)	$MgCl_2.KCl.6H_2O$	277.88	hex.
40	manganate	K_2MnO_4	197.12	grn. rhombic
41	manganicyanide	$K_3Mn(CN)_6$	328.27	red.
42	manganocyanide	$K_4Mn(CN)_6.6H_2O$	475.46	quad. bl.
43	molybdate	K_2MoO_4	138.19	wh. powd.
44	nickel sulfate	$K_2SO_4.NiSO_4.6H_2O$	437.11	monocl. bl.
45	nitrate (saltpeter)	KNO_3	101.10	rhbdr. or prism.
46	nitride	K_3N	131.30	dk. gray
47	nitrite	KNO_2	85.10	prism
48	nitroprusside	$K_2Fe(CN)_5.NO.2H_2O$	330.11	red. monocl.
49	osmate	$K_2OsO_4.2H_2O$	369.02	octahdr. violet
50	osmocyanide	$K_4Os(CN)_6.3H_2O$	557.28	yel.

INORGANIC COMPOUNDS (Continued)

		Sp. Gr. $H_2O = 1$ (A) air = 1 (D) H_2 = 1	Melting-point, Deg. C.	Boiling-point, Deg. C.	Solubility in 100 parts of		
					Cold water	Hot water	Alcohol, acids, etc.
1		3.291$^{21°}$	d.	.....	0.7$^{0°}$	5.22$^{100°}$	i. al., eth.
2		3.291$^{21°}$	.....	.....	16.6	v. s.	i. al.
3		.....	d.	.....	sl. s.	d.	i. al.
4		2.687	.....	.....	s.		
5		2.732$^{18°}$	971	.....	58.9$^{0°}$	79.1$^{100°}$	i. al.
6		1.98	d. 230	.....	167$^{15°}$	199.7$^{31°}$	sl. s. al.
7		1.906	.....	.....	v. s.	.....	i. al.
8		.....	d. 200	.....	0.09$^{0°}$	sl. s.	i. al., eth.
9		.....	.....	.....	s.	.....	i. al., eth.
10		2.212$^{\frac{20°}{4°}}$	.....	.....	25.4$^{0°}$	108.4^{49}	
11		2.048	.....	.....	s.	s.	v. sl. s. al.
12		1.52$^{15°}$	.....	.....	s.	122 $^{2103.3°}$	s. glyc., al.
13		2.692$^{4°}$	396	d.	4.9$^{0°}$	102$^{200°}$	i. al.
14		1.871$^{17°}$	d.	.....	33$^{4.5°}$	77.5$^{100°}$	sl. s. al.
15		.....	d.	.....	92$^{21°}$	dec.	
16		.....	$-3H_2O$, 100	d. 230	4.7$^{0°}$	117.7$^{100°}$	i. al.
17		1.853$^{17°}$	$-3H_2O$, 70	.....	27.8$^{12.2°}$	90.6$^{96.3°}$	i. al.
18		2.48	859.9	.....	92.3$^{18°}$	v. s.	i. al.; s. HF
19		2.454	41	.....	349.3$^{18°}$	v. s.	i. al.; s. HF
20		.....	d.	.....	41$^{21°}$	.....	i. al.; s. $KC_2H_3O_2$
21		.....	.....	.....	6.45$^{18°}$	43.5$^{100°}$	
22		2.665$^{\frac{17.4°}{4°}}$	d.	.....	0.12$^{17.5°}$	0.955$^{100°}$	i. al.; s. HCl
23		3.053	.....	.....	3.7$^{18°}$	33.3$^{100°}$	
24		.....	.....	.....	0.556$^{0°}$	1.28$^{20°}$	s. HCl
25		3.582	.....	.....	0.78$^{2°}$	25$^{100°}$	
26		1.908	150	d.	331$^{18°}$	657$^{99°}$	
27		0.8	d.	.....	dec.	dec.	i. bz., eth., CS_2
28		2.0	d.	.....	s.	s.	v. s. al.
29		2.044	360.4	subl.	97$^{0°}$, 107$^{15°}$	178$^{100°}$	v. s. al., eth.
30		.....	d.	.....	v. s.	v. s.	
31		.....	ign.	.....	v. s.	.....	s. al.; i. eth.
32		3.975$^{18°}$	560	.....	4.74$^{0°}$	32.3$^{100°}$	i. al.; s. KI
33		.....	.....	.....	1.33$^{15°}$		
34		3.115$^{\frac{24°}{4°}}$	680	1420	127.9$^{0°}$	209$^{100°}$	14.28 al.; s. eth.
35		3.498$^{15°}$	45	.....	v. s.	.....	s. al., KI
36		.....	d.				
37		1.176$^{45°}$	d.	.....	dec.	.....	d. eth.
38		.....	.....	.....	v. s.	.....	i. al.
39		1.618	.....	.....	64.5$^{18.75°}$	dec.	d. al.
40		.....	d. 190	.....	dec.	.....	s. KOH
41		.....	.....	.....	s.		
42		.....	.....	.....	s.		
43		.....	.....	.....	v. s.	v. s.	i. al.
44		2.124	.....	.....	70$^{0°}$	60.875$^{0°}$	
45		2.109$^{16°}$	337	d. 400	13.3$^{0°}$	247$^{100°}$	i. al., eth.
46		.....	.....	.....	dec.		
47		1.195$^{25°}$	297.5	d. 350	v. s.	.....	s. al.
48		.....	.....	.....	100$^{16°}$	.....	s. al.
49		.....	.....	.....	sl. s.	s.	i. al., eth.
50		.....	.....	.....	sl. s.	s.	i. al., eth.

	Name	Formula	Mol. wt.	Crystalline form and color
1	Potassium oxalate	$K_2C_2O_4.H_2O$	184.21	monocl. wh.
2	oxalate, acid	$KHC_2O_4.\frac{1}{2}H_2O$	137.11	trim.
3	oxalate, tetra-	$KH_3(C_2O_4)_2.2H_2O$	254.15	tricl.
4	oxide	K_2O	94.19	octhdr.
5	oxide, per-	K_2O_2	110.19	yel. amor.
6	perchlorate	$KClO_4$	138.55	rhombic
7	perchromate	K_3CrO_8	297.30	br. octahdr.
8	periodate	KIO_4	230.03	rhombic
9	permanganate	$KMnO_4$	158.03	dk. purp. rhombic
10	persulfate	$K_2S_2O_8$	270.32	prism
11	perruthenate	$KRuO_4$	204.80	quad. blk.
12	peruranate	$K_2UO_5.3H_2O$	450.41	red cryst.
13	phosphate, ortho-	K_3PO_4	212.32	rhombic
14	phosphate, hydrogen	K_2HPO_4	174.23	amor. wh. powd.
15	phosphate, dihydrogen	KH_2PO_4	136.14	tetrag. colorl.
16	phosphate, meta-	$K_4P_4O_{12}.2H_2O$	508.52	amor.
17	phosphate, pyro-	$K_4P_2O_7.3H_2O$	384.49	
18	phosphite	K_2HPO_3	158.23	wh. powd.
19	phosphite, hypo-	KH_2PO_2	134.14	hex. wh.
20	platinate	$K_2PtO_3.3H_2O$	375.47	yel. rhbdr.
21	platinocyanide	$K_2Pt(CN)_4.3H_2O$	431.50	yel. rhombic
22	platinonitrite	$K_2Pt(NO_2)_4$	457.45	monocl. pr.
23	plumbate	$K_2PbO_3.3H_2O$	387.44	rhbdr.
24	ruthenate	$K_2RuO_4.H_2O$	261.91	rhombic blk.
25	selenate	K_2SeO_4	221.39	
26	selenocyanide	$KCN.Se$	144.30	need.
27	silicate	K_2SiO_3	154.25	
28	silicate, tetra-	$K_2Si_4O_9$	334.43	amor.
29	silvercyanide	$KAg(CN)_2$	198.99	reg.
30	sodium carbonate	$KNaCO_3.6H_2O$	230.19	monocl.
31	sodium cobaltinitrite	$K_2NaCo(NO_2)_6.H_2O$	454.19	yel.
32	stannate	$K_2SnO_3.3H_2O$	298.94	rhbdr.
33	sulfate	K_2SO_4	174.26	rhombic or hex.
34	sulfate, acid	$KHSO_4$	136.17	monocl. or rhombic.
35	sulfate, pyro-	$K_2S_2O_7$	254.32	
36	sulfide, mono-	K_2S	110.26	br. cryst.
37	sulfide, mono-	$K_2S.5H_2O$	200.34	ortho rhombic
38	sulfide, di-	K_2S_2	142.32	yel. red
39	sulfide, tri-	K_2S_3	174.38	yel.-br. cryst.
40	sulfide, tetra-	K_2S_4	206.45	red br. cryst.
41	sulfide, penta-	K_2S_5	238.51	orange cryst.
42	sulfite	$K_2SO_3.2H_2O$	194.29	monocl. wh.
43	sulfite, acid	$KHSO_3$	120.17	need.
44	sulfite, pyro-	$K_2S_2O_5$	222.32	monocl. pl.
45	sulfocyanate	$KCNS$	97.17	prisms
46	tartrate	$K_2C_4H_4O_6.\frac{1}{2}H_2O$	235.23	monocl.
47	tartrate, acid	$KHC_4H_4O_6$	188.14	rhombic

INORGANIC COMPOUNDS (Continued)

	Sp. Gr. $H_2O = 1$ (A) air = 1 (D) H_2 = 1	Melting-point, Deg. C.	Boiling-point, Deg. C.	Solubility in 100 parts of		
				Cold water	Hot water	Alcohol, acids, etc.
1	2.08	d.	.....	$33^{16°}$		
2	anh. 2.088	d.	.....	$2.2^{0°}$	$51.5^{100°}$	
3	1.836	d.	.....	$1.8^{13°}$		
4	$2.32^{0°}_{0°}$	.....	.....	v. s.	v. s.	s. al., eth.
5	.....	.....	d.	dec.	.....	d. al.
6	$2.524^{0°}_{4°}$	610	d. 411	$0.7^{0°}$	$19.8^{100°}$	i. al., eth.
7	.....	d. 170	.....	sl. s.	.....	i. al., eth.
8	$3.618^{15°}_{4°}$	582	−O, 300	$0.66^{13°}$	s.	sl. s. KOH
9	$2.703^{0°}_{4°}$	d. 240	.....	$2.83^{0°}$	$32.35^{75°}$	d. al.; s. H_2SO_4
10	.....	d. <100	.....	$1.77^{0°}$	$4.08^{40°}$	i. al.
11	.....	d. 440	.....	sl. s.		
12	.....	d. 100	.....	dec.	dec.	d. HCl
13	.....	1340	.....	sl. s.	s.	i. al.
14	.....	d.	.....	v. s.	v. s.	v. s. al.
15	$2.338^{20°}_{4°}$	96	$-H_2O$, 400	$25^{7°}$	s.	i. al.
16	$2.264^{14.5°}$	$-2H_2O$, 100	.....	sl. s.	.....	s. a.
17	2.33	$-3H_2O$, 300	.....	s.	v. s.	i. al.
18	.....	d.	.....	v. s.	v. s.	i. al.
19	.....	d.	.....	v. s.		
20	.....	.....	.....	s.	.....	i. al.
21	$2.455^{18°}$	.....	.....	sl. s.	v. s.	s. al., eth.
22	.....	.....	.....	$3.8^{15°}$		
23	.....	.....	.....	dec.	dec.	s. KOH
24	.....	$-H_2O$, 200	.....	v. s.		
25	$3.066^{20°}_{4°}$	.....	.....	110.5°	$122.2^{100°}$	
26	.....	d. 100	.....	s.	s.	d. a.
27	.....	.....	.....	s.	s.	i. al.
28	.....	.....	.....	s.	s.	i. al.
29	.....	.....	.....	$25^{20°}$	100	4 al.
30	1.61	$-6H_2O$, 100	.....	$13^{12°}$	$20^{15°}$	
31	$1.633^{25°}_{4°}$	d. 135	.....	$0.07^{25°}$	.....	i. al.
32	3.197	.....	.....	$106.6^{100°}$	$110.5^{20°}$	i. al.; sl. s. KOH
33	$2.663^{20°}_{4°}$	1076	.....	$8.5^{0°}$	$26.2^{100°}$	i. al.
34	2.24 or 2.61	200	d.	36.3	$121.6^{100°}$	d. al.
35	2.27	>300	.....	s.	dec.	
36	2.13	.....	.....	s.	v. s.	s. al., glyc.; i. eth.
37	.....	$-3H_2O$, 150	.....	s.	.....	s. al., glyc.; i. eth.
38	.....	.....	.....	s.	dec.	s. al.
39	.....	.....	.....	s.	dec.	s. al.
40	.....	d. 850	.....	s.	.....	s. al.
41	.....	220	.....	v. s.	v. s.	v. s. al.
42	.....	d.	.....	100	v. s.	sl. s. al.
43	.....	d.	.....	s.	s.	i. al.
44	.....	d.	.....	s.	.....	sl. s. al.
45	1.906	172.3	d. 500	$177.2^{0°}$	$217^{20°}$	s. al., acet.
46	1.975	.....	.....	$50^{0°}$, $12.5^{17.5°}$	$278^{100°}$	sl. s. al.
47	1.956	.....	.....	$0.37^{0°}$	$6.1^{100°}$	i. al., acet. a.; s. a., alk.

	Name	Formula	Mol. wt.	Crystalline form and color
1	Potassium tellurate	$K_2TeO_4.5H_2O$	359.77	rhombic pr.
2	tellurite	K_2TeO_3	253.69	
3	thioantimonate	$2K_3SbS_4.9H_2O$	896.77	yel. cryst.
4	thioarsenate	K_3AsS_4	320.50	cryst.
5	thioarsenite	K_3AsS_3	288.44	
6	thiocarbonate	K_2CS_3	186.38	red br. cryst.
7	thionate, di-	$K_2S_2O_6$	238.32	hex.
8	thionate, tri-	$K_2S_3O_6$	270.38	rhombic need.
9	thionate, tetra-	$K_2S_4O_6$	302.45	hex. pr.
10	thionate, penta-	$2K_2S_5O_6.3H_2O$	723.07	rhombic pl.
11	thioplatinate	$K_2Pt_4S_6$	1051.50	bl. gray. cryst.
12	thiostannate	$K_2SnS_3.10H_2O$	473.24	dk. br. oil
13	thiosulfate	$3K_2S_2O_3.H_2O$	588.98	monocl.
14	tungstate, ortho-	$K_2WO_4.2H_2O$	362.22	tricl.
15	tungstate, meta-	$K_2W_4O_{13}.8H_2O$	1166.32	octahdr.
16	tungstate, para-	$K_6W_7O_{24}.6H_2O$	2014.67	rhombic
17	uranate	K_2UO_4	380.36	orange yel. rhombic
18	xanthogenate	$KS_2COC_2H_5$	160.26	prisms
19	Praseodymium	Pr	140.92	yel.
20	ammonium sulfate	$Pr_2(SO_4)_3.(NH_4)_2SO_4.8H_2O$	846.30	cryst.
21	bromate	$Pr_2(BrO_3)_6.18H_2O$	1373.62	grn. hex.
22	carbide	PrC_2	164.92	yel. cryst.
23	carbonate	$Pr_2(CO_3)_3.8H_2O$	605.97	cryst.
24	chloride	$PrCl_3$	247.29	grn. need.
25	chloride	$PrCl_3.7H_2O$	373.40	grn. cryst.
26	oxalate	$Pr_2(C_2O_4)_3.10H_2O$	726.00	cryst.
27	oxide, tri-	Pr_2O_3	329.84	yel. grn.
28	oxide, tetra-	PrO_4	204.92	blk.
29	oxide, per-	Pr_2O_5	361.84	
30	potassium sulfate	$Pr_2(SO_4)_3.3K_2SO_4.H_2O$	1110.82	cryst.
31	sulfate	$Pr_2(SO_4)_3$	570.03	
32	sulfate	$Pr_2(SO_4)_3.8H_2O$	714.16	cryst.
33	sulfide	Pr_2S_3	378.03	br.
34	Radium	Ra	225.95	
35	bromide	$RaBr_2$	385.78	
36	chloride	$RaCl_2$	296.86	reg. yel.
37	Rhodium	Rh	102.91	gray wh.
38	chloride	$RhCl_3$	209.28	red
39	chloride	$RhCl_3.4H_2O$	281.35	dk. red
40	hydrosulfide	$Rh(SH)_3$	202.13	br.-bl.
41	hydroxide, tri-	$Rh(OH)_3$	153.93	blk. gel.
42	hydroxide, tetra-	$Rh(OH)_4$	170.94	grn.
43	nitrate	$Rh(NO_3)_3.2H_2O$	324.97	red.
44	oxide, mono-	RhO	118.91	gray.
45	oxide, di-	RhO_2	134.91	br.
46	oxide, sesqui-	Rh_2O_3	253.82	gray cryst.
47	sulfate	$Rh_2(SO_4)_3.12H_2O$	710.20	cryst. lt. yel.
48	sulfide, mono-	RhS	134.97	bluish
49	sulfide, sesqui-	Rh_2S_3	302.01	blk. tabl.
50	sulfite	$Rh_2(SO_3)_3.6H_2O$	554.11	yel. cryst.

INORGANIC COMPOUNDS (Continued)

	Sp. Gr. $H_2O = 1$ (A) air = 1, (D) H_2 = 1	Melting-point, Deg. C.	Boiling-point, Deg. C.	Solubility in 100 parts of		
				Cold water	Hot water	Alcohol, acids, etc.
1	.....	.....	.....	sl. s.	s.	i. al.; sl. s. KOH
2	.....	.....	.....	sl. s.	s.	
3	.....	.....	.....	s.	.....	i. al.
4	.....	d.	.....	v. s.	.....	i. al.
5	.....	d.	.....	s.	.....	i. al.
6	.....	.....	.....	v. s.	.....	sl. s. al.
7	$2.278^{20°}_{4°}$	d.	.....	6	$66^{100°}$	i. al.
8	$2.304^{20°}_{4°}$	.....	.....	v. s.	dec.	i. al.
9	$2.296^{20°}_{4°}$	.....	.....	v. s.	.....	i. al.
10	$2.112^{20°}_{4°}$	d.	.....	50	dec.	i. al.
11	$6.44^{15°}$	ign.	.....	i.	.....	d. HCl
12	.....	$-10H_2O$, 103	.....	s.	.....	i. al.
13	(anh.) 2.590	$-H_2O$, 180	d.	$96.1^{0°}$	$312^{90°}$	i. al.
14	.....	.....	.....	51.5	151.5	i. al.
15	.....	.....	.....	s.	v. s.	
16	.....	d.	.....	2.15	6.6	i. al.
17	.....	.....	.....	i.	i.	v. s. a.
18	$1.558^{21.5°}$	d. >200	200	v. s.	.....	20 al.; i. eth.
19	6.4754	940	.....	dec.		
20	$2.531^{15.5°}$	$-8H_2O$, 170	.....	sl. s.		
21	.....	56.5	$-14H_2O$, 100	$190^{25°}$		
22	5.10	d.	.....	dec.	dec.	s. dil. a., H_2SO_4
23	.....	$-6H_2O$, 100	.....	i.	.....	s. a.
24	$4.017^{18°}$	818	.....	$69.5^{13°}$	v. s.	s. al.; i. chl.
25	$2.251^{16.2°}$	.....	.....	176.5	v. s.	s. HCl
26	.....	.....	.....	$0.098^{25°}$	.....	s. a.
27	$7.068^{20°}_{4°}$					
28	$5.978^{20°}_{4°}$					
29						
30	$3.275^{18°}$	.....	.....	sl. s.	.....	s. HNO_3, HCl
31	$3.72^{16°}$	.....	.....	$23.64^{0°}$	$1.01^{100°}$	
32	$2.82^{13.2°}$					
33	$5.042^{11°}$	d.	.....	i.	dec.	s. dil. a.
34	.....	700				
35	.....	subl. 900	.....	s.	s.	s. al.
36	.....	1650				
37	12.44	1950	.....	i.	i.	sl. s. a., aq. reg.
38	.....	d. 450–500	.....	i.	i.	i. a.
39	.....	.....	.....	v. s.	.....	s. al., HCl; i. eth.
40	.....	.....	.....	i.	dec.	i. a., Na_2S; s. aq. reg.
41	.....	d.	.....	i.	.....	s. a., KOH
42	.....	.....	.....	i.	.....	s. HCl
43	.....	.....	.....	s.	s.	i. al.
44	.....	.....	.....	i.	i.	i. a.
45	.....	.....	.....	i.	i.	i. a., KOH
46	.....	.....	.....	i.	i.	i. a., KOH
47	.....	.....	.....	v. s.	dec.	i. al.
48	.....	d.	.....	i.	i.	i. a., aq. reg.
49	.....	.....	.....	i.	i.	i. a.
50	.....	.....	.....	s.	.....	i. al.

	Name	Formula	Mol. wt.	Crystalline form and color
1	Rubidium	Rb	85.44	silvery wh.
2	bromide	RbBr	165.36	reg.
3	carbonate	Rb_2CO_3	230.88	wh. cryst. powd.
4	carbonate, bi-	$RbHCO_3$	146.45	rhombic pr.
5	chlorate	$RbClO_3$	168.90	trim.
6	chloride	RbCl	120.90	reg.
7	chloroplatinate	Rb_2PtCl_6	578.87	yel. reg.
8	chromate	Rb_2CrO_4	286.89	yel. rhombic
9	dichromate	$Rb_2Cr_2O_7$	386.90	tricl. or monocl.
10	fluoride	RbF	104.44	
11	fluosilicate	Rb_2SiF_6	312.94	reg.
12	hydride	RbH	86.45	prism. need.
13	hydroxide	RbOH	102.45	gray
14	iodide	RbI	212.37	reg. octahdr.
15	iodate	$RbIO_3$	260.37	cryst.
16	nitrate	$RbNO_3$	147.45	hex. or reg.
17	oxide, mon-	Rb_2O	186.88	yel. octahdr.
18	oxide, di- (per)	Rb_2O_2	202.88	yel. need.
19	oxide, tri-	Rb_2O_3	218.88	blk.
20	oxide, tetra-	Rb_2O_4	234.88	yel.
21	perchlorate	$RbClO_4$	184.90	rhombic
22	periodate	$RbIO_4$	276.37	tetrag.
23	permanganate	$RbMnO_4$	204.37	cryst.
24	sulfate	Rb_2SO_4	266.94	hex.
25	sulfide	Rb_2S	202.94	
26	sulfide	$Rb_2S.4H_2O$	275.01	cryst.
27	sulfide, penta-	Rb_2S_5	331.20	red rhombic
28	tartrate, acid	$RbHC_4H_4O_6$	234.48	trim. pr.
29	Ruthenium	Ru	101.70	blk. porous
30	Ruthenium	Ru	101.70	gr. cryst.
31	chloride, di-	$RuCl_2$	172.61	blk. cryst.
32	chloride, tri-	$RuCl_3$	208.07	br. cryst.
33	chloride, tetra-	$RuCl_4$	243.53	
34	hydroxide	$Ru(OH)_3$	152.72	blk. powd.
35	oxide, sesqui-	Ru_2O_3	251.40	bl.-blk.
36	oxide, di-	RuO_2	133.70	reg. violet
37	oxide, tetra-	RuO_4	165.70	rhombic yel.
38	oxide, penta-	Ru_2O_5	283.40	blk. cryst.
39	oxide, non-	Ru_4O_9	550.80	blk. cryst.
40	silicide	RuSi	129.76	met. pr.
41	Samarium	Sa	150.43	
42	bromate	$Sa_2(BrO_3)_6.18H_2O$	1392.64	yel. hex.
43	bromide	$SaBr_3.6H_2O$	498.27	
44	carbide	SaC_2	174.43	yel. hex.
45	chloride	$SaCl_3$	256.80	grn. yel. cryst.
46	chloride	$SaCl_3.3H_2O$	310.85	grn.
47	fluoride	$SaF_3.\frac{1}{2}H_2O$	216.44	
48	hydroxide	$Sa(OH)_3$	201.45	
49	nitrate	$Sa(NO_3)_3.6H_2O$	444.55	pa. yel. pr.
50	oxide	Sa_2O_3	348.86	
51	peroxide	Sa_4O_9	745.72	

INORGANIC COMPOUNDS (Continued)

	Sp. Gr. $H_2O = 1$ (A) air = 1 (D) H_2 = 1	Melting-point, Deg. C.	Boiling-point, Deg. C.	Solubility in 100 parts of		
				Cold water	Hot water	Alcohol, acids, etc.
1	1.532$^{20°}$	38.5	696	dec.	dec.	s. a., al.
2	3.21$^{23°}$	683	.....	98$^{5°}$	205.2$^{113.5°}$	
3	.....	837	d. 740	450$^{20°}$	s.	s. al.
4	.....	d. 175	.....	116.1	.....	s. al.
5	.....	.....	.....	2.84$^{4.7°}$	5.1$^{19°}$	
6	2.706$^{22.9°}$	726	.....	76.38$^{1°}$	138.9$^{100°}$	s. al.
7	3.94$^{17.5°}$	.....	.....	0.184$^{0°}$	0.634$^{100°}$	i. al.
8	3.518	.....	.....	62$^{0°}$	95.7$^{80°}$	
9	.....	.....	.....	5.72$^{18°}$	38.9$^{65°}$	
10	3.202$^{16.5°}$	753	.....	22.7$^{13°}$	.....	i. al., eth.
11	3.338$^{20°}$	.....	.....	0.16$^{20°}$	1.35$^{100°}$	i. al.; s. a.
12	2.0	d.	.....	dec.	dec.	d. a.
13	3.203$^{11°}$	301	.....	198$^{30°}$	v. s.	s. al.
14	3.55$^{2.5°}$	642	.....	137.5$^{6.9°}$	152$^{17.4°}$	
15	4.559$^{1.4°}$	.....	.....	2.1$^{22°}$		
16	3.131$^{15°}$	.....	.....	20.1$^{0°}$	452$^{100°}$	v. s. HNO_3
17	3.720$^{3°}$	.....	.....	s.	s.	
18	3.65$^{0°}$	600				
19	3.53$^{0°}$	<500	.....	dec.		
20	.....	600–50				
21	3.014	.....	d.	1.00$^{21.3°}$	.....	i. al.
22	3.918$^{4.8°}$	.....	.....	0.65$^{13°}$		
23	3.235$^{10.4°}$	.....	.....	0.46$^{0°}$	4.68$^{60°}$	
24	3.611$^{2.0°}$	1051	.....	36.4	81.8$^{100°}$	
25	2.912	.....	.....	v. s.	v. s.	
26	.....	.....	.....	v. s.	v. s.	
27	2.618$^{15°}$	223–4	.....	dec.	.....	s. al.
28	2.399	d.	.....	1.18$^{25°}$	11.7$^{100°}$	
29	8.6	>1950	.....	i.	i.	sl. s. a., aq. reg.
30	12.268$^{0°}$	2450 (?)	.....	i.	i.	
31	.....	.....	.....	i.	.....	i. a., alk.
32	.....	.....	.....	s.	dec.	sl. s. al.; i. a., CS_2
33	.....	.....	.....	s.	.....	s. al.
34	.....	.....	.....	.....	.....	s. a.
35	.....	.....	.....	i.	i.	i. a.
36	7.2	.....	.....	i.	i.	i. a.; s. fus. KOH
37	5.7	50	100.8, d. 106	sl. s.	.....	s. alk.
38	.....	$-\frac{1}{2}O$, 360	.....	.....	.....	s. HCl
39	.....	$-O$, 440				
40	5.40$^{0°}$	.....	.....	i.	i.	s. HNO_3 + HF
41	7.7–.8	1350				
42	.....	75	$-14H_2O$, 100 $-18H_2O$, 150	114$^{25°}$		
43	2.97$^{22°}$	.....	.....	deliq.		
44	5.86	.....	.....	dec.	dec.	s. a.
45	4.465$^{4.8°}$	686	.....	.....	.....	s. abs. al.
46	2.392	.....	.....	deliq.		
47	.....	.....	.....	i.	.....	i. a.
48	.....	.....	.....	i.	.....	s. a.; i. alk.
49	2.375	.....	.....	v. s.	.....	v. s. a.
50	8.347	.....	.....	.....	.....	
51	.....	.....	.....	i.		

PHYSICAL CONSTANTS OF

	Name	Formula	Mol. wt.	Crystalline form and color
1	Samarium sulfate	$Sa_2(SO_4)_3.8H_2O$	733.18	
2	Scandium	Sc	45.10	
3	chloride	$ScCl_3$	151.47	pl.
4	oxide	Sc_2O_3	138.20	wh. powd.
5	sulfate	$Sc_2(SO_4)_3$	378.39	
6	Selenium	Se_8	633.60	red. powd.
7	Selenium	Se_8	633.60	red monocl.
8	Selenium	Se_8	630.60	steel gr. hex.
9	bromide, mono-	Se_2Br_2	318.23	br. red liq.
10	bromide, tetra-	$SeBr_4$	398.86	orange cryst.
11	bromochloride, tri-	$SeBr_3Cl$	354.41	orange cryst.
12	bromtrichloride	$SeBrCl_3$	265.49	yel. br. cryst.
13	chloride, mono-	Se_2Cl_2	229.31	red liq.
14	chloride, tetra-	$SeCl_4$	221.03	yel. cryst.
15	iodide, mono-	Se_2I_2	412.26	steel gr. cryst.
16	iodide, tetra-	SeI_4	586.93	dk, gr. cryst.
17	oxide, di-	SeO_2	111.20	tetrag. need.
18	oxychloride	$SeOCl_2$	166.11	yel. liq.
19	oxybromide	$SeOBr_2$	255.03	yel. cryst.
20	nitride	Se_2N_2	186.42	orange yel.
21	sulfide	SeS	111.26	orange yel. tabl.
22	sulfoxide	$SeSO_3$	159.26	grn. pr.
23	sulfoxytetrachloride	$SeSO_3Cl_4$	301.09	wh. need.
24	Selenic acid	H_2SeO_4	145.22	hex. pr.
25	Selenic acid	$H_2SeO_4.H_2O$	163.23	need.
26	Selenious acid	H_2SeO_3	129.22	cryst.
27	Silicic acid, meta-	H_2SiO_3	78.08	amor.
28	Silicic acid, ortho-	H_4SiO_4	96.09	amor.
29	Silicobromoform	$SiHBr_3$	268.82	liq., colorl.
30	Silicochloroform	$SiHCl_3$	135.44	liq., colorl.
31	Silicofluoform	$SiHF_3$	86.07	gas.
32	Silicoiodoform	$SiHI_3$	409.86	red liq.
33	Silico-oxalic acid	$Si_2O_2(OH)_2$	122.14	amor. wh.
34	Silicon, cryst.	Si	28.06	gr. octahdr.
35	Silicon, graphitic	Si	28.06	cryst.
36	Silicon, amorphous	Si	28.06	br. amor.

INORGANIC COMPOUNDS (Continued)

	Sp. Gr. $H_2O = 1$ (A) air = 1 (D) H_2 = 1	Melting-point, Deg. C.	Boiling-point, Deg. C.	Solubility in 100 parts of		
				Cold water	Hot water	Alcohol, acids, etc.
1	2.930	$-8H_2O$, 450	$-3SO_3$, 1050	sl. s.		
2	.....	1350				
3	.....	subl. 800–50	.....	v. s.	v. s.	i. abs. al.
4	3.864	.....	.....	i.	i.	s. h. a.
5	2.579	.....	.....	$10.32^{25°}$		
6	4.26–.28$^{25°}$	50	690	i.	i.	s. CS_2, H_2SO_4
7	$4.47^{25°}$	170–80	690	i.	i.	s. CS_2, H_2SO_4
8	$4.8^{25°}$	217	690	i.	i.	i. CS_2, s. H_2SO_4
9	$3.604^{15°}$	.....	225–30	i.	dec.	s. CS_2, C_2H_5 Br, chl
10	.....	d. 75.	.....	s.	dec.	s. CS_2, C_2H_5 Br, chl.
11	.....	d.	.....	.....	.....	sl. s. CS_2
12	.....	190	.....	.....	.....	i. CS_2
13	$2.906^{17.5°}$	.....	145	dec.	.....	v. s. CS_2, CCl_4, chl.
14	.....	subl.	.....	dec.	.....	sl. s. CS_2; s. $POCl_3$
15	.....	68–70	d. 100	dec.	dec.	
16	.....	75–80	$-4I$, 100	dec.	dec.	
17	$3.952^{\frac{15}{4}.3°}$	390	subl. 250–80	$38.4^{14°}$	v. s.	v. s. al., acet. a.; acet.
18	2.44	10	179.5	dec.		
19	.....	30–40	.....	i.	i.	s. CS_2, CCl_4, H_2SO_4
20	.....	expl. 200	.....	i.	i.	i. al. sl. s CS_2
21	$3.056^{0°}$	d.	.....	i.	i.	s. CS_2; i. eth.
22	.....	d. 40	.....	dec.	.....	s. H_2SO_4
23	.....	165	183	dec.		
24	$2.951^{15°}$	58	260	v. s.	v. s.	s. H_2SO_4; d. al.
25	$2.627^{15°}$	25	.....	v. s.		
26	$3.007^{15.7°}$	d.	.....	v. s.	v. s.	v. s. al.
27	$1.813^{17°}$	.....	.....	i.	i.	s. alk.; i. NH_4Cl
28	$1.576^{17°}$	.....	.....	sl. s.	sl. s.	s. alk.; i. NH_4Cl
29	2.7	>-60	110	dec.		
30	1.3–.6	-1.3	34	dec.	.....	s. CS_2, CCl_4, chl.
31	(D) $2.98^{0°}$	-110	-80.2	dec.	.....	d. alk., al., eth.; s. tol.
32	$3.314^{20°}$	.....	220	dec.	.....	s. CS_2
33	.....	d.	.....	i.		
34	$2.49^{10°}$	1420	3500	i.	i.	i. HF; s. HNO_3 + HF
35	2.00–.50	.... ..	3500	i.	i.	i. HF; s. HNO_3 + HF, fus. KOH
36	2.00	.....	3500	i.	i.	s. HF, KOH

PHYSICAL CONSTANTS OF

	Name	Formula	Mol. wt.	Crystalline form and color
1	Silicon boride, tri-	SiB_3	60.52	blk. rhombic
2	boride, hexa-	SiB_6	92.98	blk. cryst
3	bromide, tri-	$SiBr_3$	267.81	rhombic
4	bromide, tetra-	$SiBr_4$	347.72	
5	bromotrichloride	$SiBrCl_3$	214.35	
6	dibromidichloride	$SiBr_2Cl_2$	258.81	liq
7	tribromchloride	$SiBr_3Cl$	303.27	liq
8	carbide	SiC	40.06	rhombic pl
9	chloride, tri-	$SiCl_3$	134.43	leaf. or liq
10	chloride, tetra-	$SiCl_4$	169.89	yel. liq
11	chlorohydrosulfide	$SiCl_3SH$	167.50	
12	fluoride	SiF_4	104.06	gas
13	hydride	SiH_4	32.09	gas
14	hydride	Si_2H_6	62.17	gas
15	hydride (trisilane)	Si_3H_8	92.24	
16	hydride (tetrasilane)	Si_4H_{10}	122.32	
17	iodide, di-	SiI_2	281.92	
18	iodide, hexa-	Si_2I_6	817.71	hex. pl
19	iodide, tetra-	SiI_4	535.79	reg. octahdr., colorl.
20	iodoform	$SiHI_3$	409.86	
21	iodotrichloride	$SiICl_3$	261.36	
22	oxide, di- (amorphous)	SiO_2	60.06	colorl. amor
23	oxide, di- (cryst.)	SiO_2	60.06	colorl. cryst
24	oxychloride	Si_2OCl_6	284.86	
25	sulfide	SiS_2	92.19	need
26	sulfobromide	$SiSBr_2$	219.96	pl
27	sulfochloride	$SiSCl_2$	131.04	pr
28	Silver	Ag	107.88	reg. wh
29	acetate	$AgC_2H_3O_2$	166.90	plates
30	arsenate	Ag_3AsO_4	462.60	dk. red
31	arsenite	Ag_3AsO_3	446.60	yel
32	bromate	$AgBrO_3$	235.80	tetrag
33	bromide	$AgBr$	187.80	reg. pa. yel
34	carbonate	Ag_2CO_3	275.76	yel. powd
35	chlorate	$AgClO_3$	191.34	tetrag. or reg

INORGANIC COMPOUNDS (Continued)

	Sp. Gr. $H_2O = 1$ (A) air = 1 (D) H_2 = 1	Melting-point, Deg. C.	Boiling-point, Deg. C.	Solubility in 100 parts of		
				Cold water	Hot water	Alcohol, acids, etc.
1	2.52	.....	.....	i.	.....	sl. s. h. H_2SO_4, HNO_3
2	2.47	.....	.....	i.	.....	sl. s. h. H_2SO_4, HNO_3
3	.....	95	265	dec.	.....	d. KOH
4	$2.813_3^{0°}$	5	153	dec.	dec.	d. H_2SO_4
5	.....	.....	80	dec.		
6	.....	>−60	103–5	dec.		
7	2.432	>−39	126–8	dec.		
8	$3.12^{15°}$	.....	.....	i.	i.	i. a.
9	1.58	−1	144–8	dec.	dec.	d. alk.
10	$1.524_4^{0°}$	−89	57.5	dec.	.....	d. al.
11	1.45	.....	96	dec.	.....	d. al.
12	(A) 3.57	−77	.....	dec.	.....	s. al., eth., HNO_3
13	.....	−185	−112	dec.	.....	d. KOH
14	$0.686^{-25°}$	−132.5	−15	dec.	.....	s. al., CS_2, bz.
15	$0.725^{0°}$	−117	ign.	dec.		
16	$0.79^{0°}$	−93.5	ign.	dec.		
17	.....	.....	.....	dec.	.....	i. CS_2, chl., bz.
18	.....	250 (vac.)	d.	dec.	dec.	$19CS_2$
19	.....	120.5	290	dec.	.....	$2.2^{27°}CS_2$
20	$3.28^{23°}$	8	d. 150	.....	.....	∞ CS_2, bz.
21	.....	.....	113–4	dec.		
22	$2.20^{15.6°}$	1600–1750	subl. 1750	i.	.....	s. h. alk., HF
23	2.318–.654	1600–1750	.....	i.	.....	i. alk., s. HF
24	(D) 10.05	.....	136–9	dec.	.....	s. CS_2, CCl_4, chl., eth.
25	.....	.....	.....	dec.	.....	s. dil. alk.; d. al.
26	.....	93	150	dec.	dec.	s. CS_2
27	.....	75	$92^{22.5mm.}$	dec.	dec.	s. CS_2
28	10.5	960.5	1955	i.	i.	s. HNO_3, h. H_2SO_4; i. alk.
29	3.259	d.	.....	$1.02^{14°}$	$2.52^{80°}$	
30	$6.66_4^{25°}$	.....	.....	$0.00085^{20°}$	.....	s. acet. a., NH_4OH, NH_4 salts
31	.....	d.	.....	$0.00115^{20°}$	i.	s. acet. a., NH_4OH, NH_4 salts
32	5.206	d.	.....	$0.158^{20°}$	.....	s. NH_4OH; sl. s. HNO_3
33	$6.473_4^{25°}$	427	d. 700	$0.000026^{25°}$	$0.00014^{100°}$	$0.051^{100°}$ NH_4OH; s. KCN
34	$6.0^{17.5°}$	d. 200	.....	$0.0031^{15°}$	$0.05^{100°}$	s. NH_4OH, $Na_2S_2O_3$; i. al.
35	$4.401^{22°}$	230	d. 270	$10^{15°}$	$50^{80°}$	i. al.

PHYSICAL CONSTANTS OF

	Name	Formula	Mol. wt.	Crystalline form and color
1	Silver chloride	$AgCl$	143.34	reg. wh.
2	chromate	Ag_2CrO_4	331.77	dk. red cryst.
3	citrate	$AgC_6H_5O_7$	296.92	need.
4	cyanate	$AgCNO$	149.89	
5	cyanide	$AgCN$	133.89	curd. wh.
6	dichromate	$Ag_2Cr_2O_7$	431.78	tricl. red
7	ferricyanide	$Ag_3Fe(CN)_6$	553.54	orange
8	ferrocyanide	$Ag_4Fe(CN)_6.H_2O$	661.42	yel.
9	fluoride	AgF	126.88	tetrag. yel.
10	fluosilicate	$Ag_2SiF_6.2H_2O$	393.85	cryst.
11	iodate	$AgIO_3$	282.81	monocl.
12	iodide	AgI	234.81	hex. or reg. yel.
13	nitrate	$AgNO_3$	169.89	hex. or rhombic colorl.
14	nitride	AgN_3	149.90	wh. prisms
15	nitrite	$AgNO_2$	153.89	wh. cryst.
16	nitroprusside	$Ag_2Fe(CN)_5NO$	431.65	lt. pink
17	oxalate	$Ag_2C_2O_4$	391.76	wh.
18	oxide	Ag_2O	231.76	br. powd.
19	oxide, per-	Ag_2O_2	247.76	blk. octahdr.
20	perchlorate	$AgClO_4$	207.24	wh.
21	permanganate	$AgMnO_4$	226.81	dk. violet, monocl.
22	phosphate, ortho-	Ag_3PO_4	418.67	yel.
23	phosphate, pyro-	$Ag_4P_2O_7$	605.57	
24	potassium cyanide	$KAg(CN)_2$	198.99	reg. octahdr.
25	selenide	Ag_2Se	294.96	gray
26	sulfate	Ag_2SO_4	311.82	rhombic wh.
27	sulfide	Ag_2S	247.82	gr.-blk. reg. or tricl.

INORGANIC COMPOUNDS (Continued)

	Sp. Gr. $H_2O = 1$ (A) air = 1 (D) $H_2 = 1$	Melting-point, Deg. C.	Boiling-point, Deg. C.	Solubility in 100 parts of		
				Cold water	Hot water	Alcohol, acids, etc.
1	5.553	455	.....	$0.000152^{20°}$	$0.0022^{100°}$	s. NH_4OH, KCN; sl. s. HCl
2	5.523	.....	.....	$0.0028^{18°}$	$0.0284^{25°}$	s. NH_4OH, KCN, a.
3	.....	d.	.....	$0.028^{18°}$	.....	s. NH_4OH, KCN
4	4.0	d.	.....	sl. s.	s.	s. HNO_3, NH_4OH, KCN
5	3.95	d.	.....	$0.000021^{25°}$	.....	s. HNO_3, NH_4OH, KCN
6	.....	d.	.....	$0.0083^{15°}$	dec.	v s. HNO_3, NH_4OH, KCN
7	.....	.....	.....	$0.000066^{20°}$	.....	s. NH_4OH, h. $(NH_4)_2CO_3$,
8	.....	.....	.....	i.	i.	s. NH_4OH, KCN; i. a.
9	$5.852^{15.5°}$	435	.....	$182^{15.5°}$		
10	.....	<100	d.	v. s.		
11	5.40–.65	d.	.....	$0.00385^{18°}$	sl. s.	s. NH_4OH, HNO_3, KI
12	$5.675^{25°}_{4}$	526–56	.....	$0.000035^{21°}$	.....	s. KCN, $Na_2S_2O_3$; NaCl
13	$4.352^{19°}$	218	d.	$121.9^{0°}$	$940^{100°}$	66 al.; s. eth., glyc.
14	.....	250	expl.	i.	$0.01^{100°}$	s. dil. HNO_3
15	$4.453^{25°}$	.....	.....	0.33	s.	i. al.
16	.....	.....	.....	i.	.....	i. al., HNO_3; s. NH_4OH
17	$5.029^{4°}$	d.	.....	$0.00339^{18°}$	.....	s. NH_4OH, KCN
18	7.521	—O, 300–40	.....	$0.00215^{20°}$	.....	s. NH_4OH, KCN
19	5.474	d. >100	.....	i.	.....	s. H_2SO_4, HNO_3, NH_4OH
20	.....	486	.....	s.	s.	
21	.....	d.	.....	$0.55^{0°}$	$1.69^{28.5°}$	
22	7.32	849	.....	$0.00193^{20°}$	.....	s. a., NH_4OH, KCN
23	$5.306^{7.5°}$	585	.....	i.	i.	s. NH_4OH, KCN, HNO_3, H_2SO_4
24	.....	.....	.....	$25^{20°}$	v. s.	4 al.; i. a.
25	8.0	897	.....	i.	.....	s. h. HNO_3, NH_4OH
26	5.40	655	d.	$0.73^{14.5°}$	$1.393^{100°}$	s. NH_4OH, HNO_3, H_2SO_4; i. al.
27	7.08	842	d.	0.00002	.....	s. H_2SO_4, HNO_3

PHYSICAL CONSTANTS OF

	Name	Formula	Mol. wt.	Crystalline form and color
1	Silver sulfite	Ag_2SO_3	295.82	cryst. wh.
2	sulfocyanate	AgCNS	165.95	curd. wh.
3	tartrate	$Ag_2C_4H_4O_6$	363.79	scales
4	telluride	Ag_2Te	343.26	gr. octahdr.
5	thiosulfate	$Ag_2S_2O_3$	325.89	wh.
6	tungstate	Ag_2WO_4	463.76	pa. yel. cryst.
7	Sodium	Na	23.00	tetrag, silvery
8	acetate	$NaC_2H_3O_2.3H_2O$	136.07	monocl. pr.
9	aluminate	$Na_2Al_2O_4$	163.93	amor.
10	amide	$NaNH_2$	39.02	olive grn.
11	ammonium phosphate	$NaNH_4HPO_4.4H_2O$	209.14	monocl.
12	antimonate	$2NaSbO_3.7H_2O$	511.65	octahdr.
13	antimonate, pyro-	$Na_2H_2Sb_2O_7.H_2O$	421.57	
14	arsenate	$Na_3AsO_4.12H_2O$	424.14	
15	arsenate, acid	$Na_2HAsO_4.7H_2O$	312.07	monocl. colorl.
16	arsenate, acid	$Na_2HAsO_4.12H_2O$	402.15	monocl. or rhombic
17	arsenite	Na_2HAsO_3	169.96	
18	aurosulfide	$NaAuS.4H_2O$	324.33	monocl.
19	benzoate	$NaC_7H_5O_2$	144.04	colorl. cryst.
20	borate, meta-	$NaBO_2$	65.82	hex. pr.
21	borate, meta-	$Na_2B_2O_4.4H_2O$	203.70	monocl.
22	borate, tetra-	$Na_2B_4O_7$	201.27	
23	borate, tetra-	$Na_2B_4O_7.5H_2O$	291.35	octahdr.
24	borate, tetra- (borax)	$Na_2B_4O_7.10H_2O$	381.43	monocl. wh.
25	bromate	$NaBrO_3$	150.91	reg. colorl.
26	bromide	NaBr	102.91	reg.
27	bromide	$NaBr.2H_2O$	138.95	monocl.
28	bromplatinate	$Na_2PtBr_6.6H_2O$	828.82	dk. red tricl.
29	carbide	Na_2C_2	69.99	powd.
30	carbonate	Na_2CO_3	105.99	wh. powd.
31	carbonate	$Na_2CO_3.H_2O$	124.01	wh. cryst.
32	carbonate (washing soda)	$Na_2CO_3.10H_2O$	286.15	moncl.
33	carbonate, acid (baking soda)	$NaHCO_3$	84.01	monocl.
34	carbonate, sesqui-	$Na_4H_2(CO_3)_3.3H_2O$	328.05	monocl.
35	chlorate	$NaClO_3$	106.45	reg. tetrag.
36	chloraurate	$NaAuCl_4.2H_2O$	398.06	
37	chloride (common salt)	NaCl	58.45	reg.
38	chlororhodate	Na_3RhCl_6	384.64	
39	chloriridate	$Na_2IrCl_6.6H_2O$	559.93	red tricl.
40	chloroplatinate	$Na_2PtCl_6.6H_2O$	562.06	red tricl.

INORGANIC COMPOUNDS (Continued)

	Sp. Gr. $H_2O = 1$ (A) air = 1 (D) $H_2 = 1$	Melting-point, Deg. C.	Boiling-point, Deg. C.	Solubility in 100 parts of		
				Cold water	Hot water	Alcohol, acids, etc.
1	.....	d.100	.....	sl. s.	.....	s. NH_4OH; i. HNO_3
2	.....	.....	.....	$0.000021^{25°}$	.....	i. dil. a.; s. NH_4OH
3	3.432	d.	.....	$0.2^{18°}$	$0.203^{25°}$	s. NH_4OH, KCN
4	8.318	955	.....	i.	.....	s. HNO_3, KCN
5	.....	d.	.....	sl. s.	.....	s. NH_4OH, $Na_2S_2O_3$
6	.....	.....	.....	$0.05^{15°}$	.....	s. HNO_3, NH_4OH. KCN
7	$0.971^{20°}$	97.6	880	dec.	dec.	i. bz.
8	1.45	58, anh. 319	.....	$26^{6°}$	200	$2.1^{18°}$ al.
9	.....	1800	.....	s.	v. s.	i. al.
10	.....	155	400	dec.	dec.	
11	1.554	d.	.....	16.7	100	i. al.
12	.....	.....	.....	$0.31^{12.5°}$	.....	sl. s. al., NH_4 salts
13	.....	.....	.....	sl. s.	sl. s.	sl. s. al.
14	1.759	85.5	.....	$26.7^{17°}$		
15	.....	57	$-7H_2O$, 100	$61^{15°}$	v. s.	sl. s. al.
16	1.67–.76	28	$-12H_2O$, 100	$17.2^{0°}$	$140.7^{30°}$	sl. s. al.
17	1.87	.....	.....	v. s.	sl. s.	
18	.....	.....	.....	s.	.....	s. al.
19	.....	.....	.....	$62.5^{25°}$	$76.9^{100°}$	$2.3^{25°}$, $8.3^{78°}$ al.
20	.....	966	.....	s.	v. s.	
21	.....	57	.....	s.	v. s.	
22	2.367	741	.....	$1.3^{5°}$	$52.5^{100°}$	i. al.
23	1.815	.....	.....	$1.9^{5°}$	$99.1^{100°}$	
24	$1.694^{17°}$	.....	.....	$2.83^{0°}$	$201.4^{100°}$	i. a.; s. glyc.
25	$3.339^{17.5°}$	381	.....	$27.54^{0°}$	$90.9^{100°}$	i. al.
26	3.014	768	1455	$79.5^{0°}$	$115^{100°}$	sl. s. al.
27	2.176	.....	.....	$172.5^{0°}$	259.5^{100}	sl. s. al.
28	3.323	d.	.....	v. s.	.....	v. s. al.
29	$1.575^{15°}$	.....	.....	dec.	dec.	s. a.; d. al.
30	2.476	852	d.	$7.1^{0°}$	$45.4^{100°}$	i. al.
31	.....	$-H_2O$, 100	.....	s.	s.	i. al., eth.; s. glyc.
32	1.458	$-5H_2O$, 12.5, 34	106	$21.52^{0°}$	$420.68^{104°}$	i. al.
33	2.206	$-CO_2$, 270	.....	$6.90^{0°}$	$16.4^{60°}$	i. al.
34	2.112	d.	.....	$12.63^{0°}$	$41.59^{100°}$	
35	$2.490^{15°}$	255	d.	$81.9^{0°}$	$333^{120°}$	s. al.
36	.....	.....	.....	$150^{10°}$	$990^{60°}$	v. s. abs. al.
37	2.17	805	1490	$35.7^{0°}$	$39.8^{100°}$	sl. s. al.; i. HCl
38	.....	.....	.....	v. s.	v. s.	s. al.
39	2.499	$-6H_2O$, 100	.....	v. s.	v. s.	s. al., Cl_2 aq.; i. eth.

PHYSICAL CONSTANTS OF

	Name	Formula	Mol. wt.	Crystalline form and color
1	Sodium chromate	$Na_2CrO_4.10H_2O$	342.16	yel. tricl.
2	citrate	$2Na_3C_6H_5O_7.11H_2O$	714.24	wh. cryst.
3	cyanide	$NaCN$	49.01	wh. cryst.
4	dichromate	$Na_2Cr_2O_7.2H_2O$	298.05	red tricl.
5	dithionate	$Na_2S_2O_6.2H_2O$	242.15	rhombic
6	ferricyanide	$Na_3Fe(CN)_6.H_2O$	298.90	red.
7	ferric oxalate	$Na_3Fe(C_2O_4)_3.5\frac{1}{2}H_2O$	487.92	grn. cryst.
8	ferrite	$Na_2Fe_2O_4$	221.67	
9	ferrocyanide	$Na_4Fe(CN)_6.12H_2O$	520.07	yel. monocl.
10	fluoride	NaF	42.00	reg.
11	fluosilicate	Na_2SiF_6	188.05	gelat. or hex.
12	formate	$NaCHO_2$	68.01	rhombic
13	hydride	NaH	24.01	silvery need.
14	hydrosulfide	$NaSH.2H_2O$	92.10	need.
15	hydrosulfite	$Na_2S_2O_4.2H_2O$	210.15	colorl. cryst.
16	hydroxide	$NaOH$	40.01	wh.
17	hypochlorite	$NaOCl$	74.45	need.
18	hypophosphate	$Na_4P_2O_6.10H_2O$	430.20	
19	hypophosphate, acid	$Na_2H_2P_2O_6.6H_2O$	314.16	
20	hypophosphite	$NaH_2PO_2.H_2O$	106.06	monocl. pr. colorl.
21	hyposulfite	$NaHSO_2$	88.07	
22	iodate	$NaIO_3$	197.93	
23	iodide	NaI	149.93	reg.
24	iodide	$NaI.2H_2O$	185.96	monocl.
25	lactate	$NaC_3H_5O_3$	112.04	amor.
26	manganate	$Na_2MnO_4.10H_2O$	345.08	monocl. gr.
27	molybdate	$Na_2MoO_4.2H_2O$	242.03	tabl.
28	molybdate, di-	$Na_2Mo_2O_7$	349.99	need.
29	molybdate, tri-	$Na_2Mo_3O_{10}.7H_2O$	620.11	need.
30	molybdate, tetra-	$Na_2Mo_4O_{13}.6H_2O$	746.09	
31	molybdate, octo-	$Na_2Mo_8O_{25}.4H_2O$	1286.06	powd.
32	molybdate, deka-	$Na_2Mo_{10}O_{31}.12H_2O$	1718.19	cryst.
33	nitrate	$NaNO_3$	81.01	rhbdr.
34	nitride	Na_3N	83.00	dk. gray
35	nitrite	$NaNO_2$	69.01	cryst.
36	nitroprusside	$Na_2Fe(CN)_5NO.2H_2O$	297.91	tricl. red.
37	oxalate	$Na_2C_2O_4$	133.99	wh. cryst. powd.
38	oxalate, acid	$NaHC_2O_4.H_2O$	130.02	monocl.
39	oxide	Na_2O	61.99	gray.
40	paratungstate	$Na_6W_7O_{24}.16H_2O$	2098.24	tricl.
41	perborate	$NaBO_3.H_2O$	99.83	
42	perborate	$NaBO_3.4H_2O$	153.88	cryst.
43	perchlorate	$NaClO_4$	122.45	rhbdr.
44	perchromate	Na_3CrO_8	249.00	orange pl.
45	permanganate	$NaMnO_4.3H_2O$	195.98	purp. cryst.
46	peroxide	Na_2O_2	77.99	yel. powd.
47	perruthenate	$NaRuO_4.H_2O$	206.71	blk. cryst.

INORGANIC COMPOUNDS (Continued)

	Sp. Gr. $H_2O = 1$ (A) air = 1 (D) H_2 = 1	Melting-point, Deg. C.	Boiling-point, Deg. C.	Solubility in 100 parts of		
				Cold water	Hot water	Alcohol, acids, etc.
1	$2.71^{16°}$	19.92	.....	v. s.	∞	sl. s. al.
2	.....	$-11H_2O$, 150	d.	$91^{25°}$	$250^{100°}$	sl. s. al.
3	.....	.....	.....	s.	v. s.	sl. s. al.
4	$2.52^{18°}$	$-2H_2O$, 100; anh. 320	d. 400	$239^{90°}$; anh. $163^{90°}$	$1226^{98°}$; anh. $433^{100°}$	
5	$2.175^{11°}$	.....	.....	$47.6^{16°}$	$90.9^{100°}$	i. al., HCl
6	.....	.....	.....	$18.9^{0°}$	$80^{100°}$	i. al.
7	$1.973^{17.5°}$	$-4H_2O$, 100	$-5\frac{1}{2}H_2O$, 200	$32.5^{0°}$	$182^{100°}$	
8	.....	.....	.....	dec.	.....	v. s. dil. HCl
9	1.458	.....	.....	$22^{15.5°}$	.....	i. al.
10	2.766	992	.....	$4^{15°}$	.....	sl. s. al..
11	$2.755^{17.5°}$	d.	.....	$0.65^{17.5°}$	$2.46^{100°}$	i. al.
12	1.919	d.	.....	$44^{0°}$	$160^{100°}$	sl. s. al.; i. eth.
13	0.92	d.	.....	dec.	dec.	i. CS_2, CCl_4, bz.
14	.....	d.	.....	s.	s.	s. al.
15	.....	d.	.....	v. s.	dec.	i. al.
16	2.13	318	.....	$42^{0°}$, $109^{29°}$	$365^{100°}$	v. s. al., eth., glyc.
17	.....	d.	.....	s.	dec.	
18	1.832	.....	.....	33	v. s.	
19	1.840	d.	.....	2.2	20	i. al.
20	.....	.....	.....	s.	s.	v. s. al.
21	.....	.....	.....	v. s.	.....	s. al.
22	4.277	d.	.....	$2.52^{0°}$	$33.9^{100°}$	i. al.; s. acet. a.
23	$3.665^{\frac{4}{4}5°}$	664	1350	$159^{0°}$	$312^{100°}$	v. s. al.
24	2.448	.....	.....	$317.9^{0°}$	$1550^{100°}$	
25	.....	d.	.....	v. s.	.....	s. al.; i. eth.
26	.....	17	.....	s.	d.	
27	.....	.....	.....	$56.2^{0°}$	$115.5^{100°}$	
28	.....	612	.....	sl. s.	sl. s.	
29	.....	.....	.....	$3.878^{20°}$	$13.7^{100°}$	
30	.....	.....	.....	sl. s.	v. s.	
31	.....	.....	.....	i.	i.	
32	.....	.....	.....	sl. s.	sl. s.	
33	$2.265^{15°}$	316	d. 380	$72.9^{0°}$	$180^{100°}$	sl. s. al., glyc.
34						
35	$2.157^{25°}$	271	d. 320	$83.3^{20°}$	v. s.	$0.31^{19.5°}$ eth., $4.43^{19.5°}$ meth. al.; sl. s. al.
36	$1.680^{17°}$	.....	.....	$40^{15°}$		
37	.....	.....	.....	$3.22^{15.5°}$	$6.33^{100°}$	
38	.....	.....	.....	$1.7^{15°}$		
39	2.27	.....	subl.	dec.	dec.	d. al.
40	.....	$-16H_2O$, 300	.....	s	dec.	
41	.....	d. 40	.....	$2.55^{15°}$	$3.78^{32°}$	s. glyc.
42	.....	.....	.....	sl. s.	dec.	s. a.
43	.....	482	d.	s.	v. s.	s. al.
44	.....	d. 115	.....	sl. s.	.....	i. al., eth.
45	.....	d.	.....	v. s.	v. s.	
46	2.805	d.	.....	a.	dec.	s. dil. a.
47	.....	.....	.....	sl. s.		

PHYSICAL CONSTANTS OF

	Name	Formula	Mol. wt.	Crystalline form and color
1	Sodium peruranate	$Na_2UO_5.5H_2O$	454.24	red cryst.
2	phosphate, tribasic	$Na_3PO_4.12H_2O$	380.21	hex.
3	phosphate, dibasic	$Na_2HPO_4.12H_2O$	358.22	rhombic
4	phosphate, monobasic	$NaH_2PO_4.H_2O$	138.06	rhombic
5	phosphate, meta-	$Na_4P_4O_{12}$	408.10	
6	phosphate, pyro-	$Na_4P_2O_7.10H_2O$	446.20	monocl.
7	phosphate, pyro-disodium	$Na_2H_2P_2O_7.6H_2O$	330.16	
8	phosphite	$Na_2HPO_3.5H_2O$	216.11	rhbdr.
9	phosphite, acid	$2Na_2H_2PO_3.5H_2O$	298.16	
10	platinate	$Na_2PtO_3.3H_2O$	343.27	yel.
11	potassium carbonate	$NaKCO_3.6H_2O$	230.19	monocl.
12	potassium tartrate (Rochelle salt)	$NaKC_4H_4O_6.4H_2O$	282.19	trim. prisms
13	salicylate	$NaC_7H_5O_3$	160.04	wh. scales
14	selenate	Na_2SeO_4	189.19	
15	selenide	Na_2Se	125.19	cryst.
16	silicate	Na_2SiO_3	122.05	monocl.
17	silicate (water glass)	$Na_2Si_4O_9$	302.23	amor.
18	silicate	$Na_2SiO_3.9H_2O$	284.20	
19	stannate	$Na_2SnO_3.3H_2O$	266.74	hex. plates
20	sulfate	Na_2SO_4	142.06	rhomb., monocl., or hex.
21	sulfate	$Na_2SO_4.7H_2O$	268.17	rhomb. or tetrag.
22	sulfate	$Na_2SO_4.10H_2O$	322.22	monocl.
23	sulfate, acid	$NaHSO_4$	120.07	tricl.
24	sulfide, mono-	Na_2S	78.06	amor. pink
25	sulfide, penta-	Na_2S_5	206.31	
26	sufite	Na_2SO_3	126.06	hex. pr.
27	sulfite	$Na_2SO_3.7H_2O$	252.17	monocl. pr.
28	sulfite, acid	$NaHSO_3$	104.07	monocl.
29	sulfocyanate	$NaCNS$	81.07	rhomb. pl.
30	tartrate	$Na_2C_4H_4O_6.2H_2O$	230.06	trim. pr.
31	thioantimonate (Schlippe's salt)	$Na_3SbS_4.9H_2O$	481.16	yel. reg.
32	thioarsenate	$2Na_3AsS_4.15H_2O$	814.65	yel. monocl.
33	thiocarbonate	$Na_2CS_3.H_2O$	172.20	yel.
34	thioplatinate	$Na_4Pt_2S_6$	870.06	red rhombic. need.
35	thiosulfate (hypo)	$Na_2S_2O_3.5H_2O$	248.20	monocl pr.
36	tungstate	$Na_2WO_4.2H_2O$	330.03	rhombic tabl.
37	uranate	Na_2UO_4	348.16	yel.
38	vanadate	$Na_3VO_4.16H_2O$	472.21	cryst.
39	Stannous and stannic *see under tin*			
40	Strontium	Sr	87.63	silvery cryst.
41	arsenate	$SrHAsO_4.H_2O$	245.61	rhombic need.
42	arsenite	$Sr_3(AsO_3)_2.4H_2O$	580.87	cryst.

INORGANIC COMPOUNDS (Continued)

	Sp. Gr. $H_2O = 1$ (A) air = 1 (D) H_2 = 1	Melting-point, Deg. C.	Boiling-point, Deg. C.	Solubility in 100 parts of		
				Cold water	Hot water	Alcohol, acids, etc.
1	.....	d. 100	.....	dec.	dec.	d. HCl
2	1.645	77	$-11H_2O$, 100	$28.3^{15°}$	∞	
3	$1.524^{16°}$	35	$-12H_2O$, 100	$6.3^{0°}$	∞	i. al.
4	2.040	$-2H_2O$, 200	.....	v. s.	v. s.	i. al.
5	2.476	617	.....	sl. s.	sl. s.	s. a., alk.
6	1.83	anh. 988	.....	$5.4^{0°}$	$93^{100°}$	i. al.
7	1.848					
8	.....	53	.....	s.	v. s.	i. al.
9	.....	42	$-5H_2O$, 100	$56^{0°}$	$193^{42°}$	
10	.....	$-3H_2O$, 150–70	.....	s.	.....	i. al.
11	1.633	$-6H_2O$, 100	.....	$185^{15°}$		
12	1.77	70–80	$-4H_2O$, 215	$26^{0°}$	$66^{28°}$	
13	.....	.....	.....	$111^{15°}$	$125^{25°}$	$17^{15°}$ al.
14	$2.309^{17.2°}$	.....	.....	$13.3^{0°}$	$72.8^{100°}$	
15	.....	>875	.....	dec.		
16	.....	1056	.....	s.	s.	i. al., Na and K salts
17	.....	.....	.....	s.	s.	i. al., Na and K salts
18	.....	48	$-6H_2O$, 100	v. s.	v. s.	$29.3^{17.5°}$ n/2 NaOH
19	.....	.....	.....	$67.4^{0°}$	$61.3^{20°}$	i. al.
20	$2.673^{15°}$	884	.....	$5.02^{0°}$	$42.5^{100°}$	i. al.
21	.....	.....	.....	$19.5^{0°}$, $37^{15°}$	$53^{25°}$	
22	$1.492^{20°}$	32.38	.....	$5^{0°}$, $19.4^{20°}$	$50.65^{32°}$	i. al.
23	$2.435^{13°}$	300	.....	$50^{0°}$	$100^{100°}$	d. al.
24	2.471	.....	.....	$15.4^{10°}$	$59.2^{90°}$	sl. s. al.; i. eth.
25	.....	.....	.....	s.	s.	sl. s. al.
26	$2.633^{4°}_{4°}$	150	d.	$28.04^{87°}$	$28.26^{84°}$	i. al.
27	$1.594^{4°}_{4°}$	$-7H_2O$, 150	d.	$32.83^{0°}$	$196^{40°}$	i. al.
28	1.48	d.	.....	sl. s.	s.	i. al.
29	.....	287	.....	v. s.	v. s.	v. s. al.
30	1.794	.....	.....	$29^{6°}$	$66^{43°}$	i. al.
31	1.864	.....	.....	33	.....	i. al.
32	.....	.....	.....	v. s.	.....	i. al.
33	.....	d.	.....	s.	dec.	
34	.....	.....	.....	i.	dec.	
35	$1.729^{17°}$	48	d. 220	$74.7^{0°}$	$301.5^{60°}$	i. al.
36	$3.259^{17.5°}$	$-2H_2O$, 100; anh. 698	.....	$41^{0°}$	$123.5^{100°}$	i. al., a.
37	.....	.....	.....	i.	i.	s. dil. a.
38	.....	866 anh.	.....	v. s.	.....	i. al.
39						
40	2.54	900	ign.	dec.	dec.	s. a., al.
41	$3.606^{15°}$	$-H_2O$, 125	$-1\frac{1}{2}H_2O$, 225	$0.284^{15.5°}$	dec.	s. a.
42	.....	.....	.....	sl. s.	.....	sl. s. al.

PHYSICAL CONSTANTS OF

	Name	Formula	Mol. wt.	Crystalline form and color
1	Strontium borate	$SrB_4O_7.4H_2O$	314.97	
2	boride	SrB_6	152.55	blk. cryst
3	bromate	$Sr(BrO_3)_2.H_2O$	361.48	monocl. pr
4	bromide	$SrBr_2$	247.46	wh. need
5	bromide	$SrBr_2.6H_2O$	355.56	colorl. cryst
6	carbide	SrC_2	111.63	blk. cryst
7	carbonate	$SrCO_3$	147.63	rhombic, wh
8	chlorate	$Sr(ClO_3)_2$	254.54	rhombic wh
9	chlorate	$Sr(ClO_3)_2.8H_2O$	398.67	need. wh
10	chloride	$SrCl_2$	158.54	wh
11	chloride	$SrCl_2.6H_2O$	266.64	hex. need., wh
12	chromate	$SrCrO_4$	203.64	monocl. pr. yel
13	cyanide	$Sr(CN)_2.4H_2O$	211.71	cryst
14	dithionate	$SrS_2O_6.4H_2O$	319.82	hex. pl
15	ferrocyanide	$Sr_2Fe(CN)_6.15H_2O$	657.39	yel. monocl
16	fluoride	SrF_2	125.63	reg. octahdr. wh
17	fluosilicate	$SrSiF_6.2H_2O$	265.72	tetrag. pr
18	formate	$Sr(CHO_2)_2.2H_2O$	213.68	rhombic
19	hydrosulfide	$Sr(SH)_2$	153.77	cryst
20	hydroxide	$Sr(OH)_2$	121.65	wh
21	hydroxide	$Sr(OH)_2.8H_2O$	265.77	tetrag. colorl
22	iodide	SrI_2	341.49	plates
23	iodide	$SrI_2.6H_2O$	449.59	colorl. cryst
24	molybdate	$SrMoO_4$	247.63	
25	nitrate	$Sr(NO_3)_2$	211.65	reg. octahdr
26	nitrate	$Sr(NO_3)_2.4H_2O$	283.71	tricl. wh
27	nitrite	$Sr(NO_2)_2.H_2O$	197.66	hex
28	oxalate	$SrC_2O_4.H_2O$	193.65	colorl
29	oxide	SrO	103.63	rhomb. gr. wh
30	oxide, per-	SrO_2	119.63	
31	oxide, per-	$SrO_2.8H_2O$	263.76	cryst. wh
32	permanganate	$Sr(MnO_4)_2.3H_2O$	379.54	purp. reg
33	phosphate, acid	$SrHPO_4$	183.67	rhombic pl
34	salicylate	$Sr(C_7H_5O_3)_2.2H_2O$	397.74	cryst. colorl
35	selenate	$SrSeO_4$	230.83	rhombic
36	silicate	$SrSiO_3$	163.69	prisms
37	sulfate	$SrSO_4$	183.69	rhombic wh
38	sulfate, acid	$Sr(HSO_4)_2$	281.77	
39	sulfide, mono-	SrS	119.69	reg. lt. gr
40	sulfide, tetra-	$SrS_4.6H_2O$	323.98	reddish cryst
41	sulfite	$SrSO_3$	167.69	cryst
42	sulfocyanate	$Sr(CNS)_2.3H_2O$	257.82	
43	tartrate	$SrC_4H_4O_6.4H_2O$	307.73	monocl. prisms wh.
44	thiosulfate	$SrS_2O_3.5H_2O$	289.84	monocl
45	Sulfur, amorphous	S_8	256.51	pa. yel

INORGANIC COMPOUNDS (Continued)

	Sp. Gr. $H_2O = 1$ (A) air = 1 (D) H_2 = 1	Melting-point, Deg. C.	Boiling-point, Deg. C.	Solubility in 100 parts of		
				Cold water	Hot water	Alcohol, acids, etc.
1	.....	.....	.....	.....	$77^{100°}$	s. HNO_3, NH_4 salts
2	$3.28^{15°}$	.....	.....	i.	i.	s. HNO_3
3	3.773	$-H_2O$, 120	d. 240	$33^{18°}$		
4	$4.216^{24°}_{4}$	498–630	d.	$87.7^{0°}$	$250^{110°}$	s. al., amyl. al.
5	2.358	.....	.....	$204.2^{0°}$	∞	
6	3.19	.....	.....	dec.	dec.	d. a.
7	3.62	d. 1155	.....	$0.0011^{18°}$	.....	0.12 CO_2 aq.; s. a., NH_4 salts
8	3.152	d. 290	.....	$174.9^{18°}$	v. s.	s. al.
9	.....	.....	.....	s.	v. s.	s. al.
10	3.054	872	.....	$44.2^{0°}$	$101.9^{100°}$	s. abs. al.
11	$1.964^{18.7°}$	$-4H_2O$, 60; 112	$-6H_2O$, 100	$106.2^{0°}$	$205.8^{40°}$	
12	$3.895^{15°}$	.....	.....	$0.12^{15°}$	.....	s. acet. a., NH_4 salts
13	.....	d.	.....	v. s.		
14	2.373	$-4H_2O$, 78	.....	$22^{16°}$	$67^{100°}$	i. al.
15	.....	.....	.....	50	100	
16	4.21	902	d. 1000	$0.012^{18°}$	sl. s.	i. HF; s. HCl
17	2.999	d.	.....	$3.2^{15°}$	.....	$0.06^{15°}$ 50% al.; s. HCl
18	2.25	d.	.....	s.	s.	
19	.....	d.	.....	s.	d.	
20	3.625	375	.....	0.41°°	$21.83^{100°}$	s. NH_4Cl
21	$1.396^{16°}$	.....	.....	0.90°°	$47.71^{100°}$	s. NH_4Cl
22	$4.549^{2.5°}_{4}$	507	d.	$164^{0°}$	$370^{100°}$	
23	4.415	.....	.....	$448.9^{0°}$	∞	
24	4.145	.....	.....	$0.0104^{17°}$		
25	$2.98^{18.8°}$	645	.....	$39.5^{0°}$	$101.1^{100°}$	0.012 abs. al.
26	$2.249^{15.5°}$	.....	.....	$60.43^{0°}$	$206.5^{100°}$	i. HNO_3
27	$2.645^{27°}$	$-H_2O$, 44	.....	$62.83^{19.5°}$		
28	.....	d.	.....	$0.005^{18°}$	$5^{100°}$	s. HCl, HNO_3
29	4.34	3000	.....	d. $Sr(OH)_2$	.....	sl. s. al.; i. eth.
30	.....	d.	.....	$0.008^{20°}$	dec.	v. s. al., NH_4Cl
31	.....	$-8H_2O$, 100	d.	$0.018^{20°}$	dec.	i. NH_4OH
32	.....	dec.	.....	$270^{0°}$	$291^{18°}$	
33	$3.544^{15°}$	.....	.....	i.	i.	s. a., NH_4 salts
34	.....	.....	.....	5.6°°	$28.6^{100°}$	$1.5^{25°}$, $9.5^{78°}$ al.
35	4.23	.....	.....	i.	.....	i. HNO_3; s. h. HCl
36	$3.652^{3.5°}_{4}$	1578	.....	i.		
37	3.71–.97	1605	d.	$0.0114^{18°}$	$0.0104^{100°}$	i. dil. H_2SO_4, al.; sl. s. a.
38	.....	d.	.....	dec.	.....	$14^{70°}$ H_2SO_4
39	$3.72^{16°}$	.....	.....	s. dec.	.....	s. al.
40	.....	.....	.....	s.	.....	s. sl.
41	.....	d.	.....	0.0033	.....	v. s. H_2SO_3
42	.....	$-3H_2O$, 100	d. 160–70	v. s.	.....	v. s. al.
43	$1.906^{2.0°}_{4}$	.....	.....	$0.112^{0°}$	$0.755^{85°}$	
44	$2.178^{17°}$	$-4H_2O^{100°}$	.....	$25^{12°}$	$57^{100°}$	s. al.
45	2.046	120	444.7	i.	i.	s. s. CS_2

PHYSICAL CONSTANTS OF

	Name	Formula	Mol. wt.	Crystalline form and color
1	Sulfur, monoclinic	S_8	256.51	pa. yel.
2	Sulfur, rhombic	S_8	256.51	yel.
3	Sulfur chloride, mono-	S_2Cl_2	135.04	yel. red liq.
4	chloride, di-	SCl_2	102.98	dk. red liq.
5	chloride, tetra-	SCl_4	173.89	yel. br. liq.
6	bromide, mono-	S_2Br_2	223.96	red liq.
7	chloriodide	SCl_7I	407.20	red yel. pr.
8	iodide	SI_6	793.66	gray-blk. cryst.
9	hexafluoride	SF_6	146.06	gas.
10	monoxytetrachloride	S_2OCl_4	221.96	deep red liq.
11	oxide, di-	SO_2	64.06	colorl. gas.
12	oxide, sesqui-	S_2O_3	112.13	bl. grn. cryst.
13	oxide, α-tri-	SO_3	80.06	prism. cryst. or liq.
14	oxide, β-tri-	$(SO_3)_2$	160.13	silky need.
15	oxide, hepta-	S_2O_7	176.13	need. or liq.
16	pentoxydichloride	$S_2O_5Cl_2$	215.04	liq.
17	trioxytetrachloride	$S_2O_3Cl_4$	253.96	cryst.
18	Sulfuric acid	H_2SO_4	98.08	colorl. liq.
19	Sulfuric acid	$H_2SO_4.H_2O$	116.10	prisms or liq.
20	Sulfuric acid	$H_2SO_4.2H_2O$	134.11	colorl. liq.
21	Sulfuric acid, pyro-	$H_2S_2O_7$	178.14	cryst.
22	Sulfuric oxychloride	SO_2Cl_2	134.98	liq.
23	oxyfluoride	SO_2F_2	102.06	gas.
24	Sulfurous oxybromide	$SOBr_2$	207.90	orange yel.
25	oxychloride	$SOCl_2$	118.98	liq.
26	oxyfluoride	SOF_2	86.06	gas.
27	Tantalum	Ta	181.50	blk-gr. cryst.
28	bromide	$TaBr_5$	581.08	yel. cryst.
29	chloride	$TaCl_5$	358.79	lt. yel. pr.
30	fluoride	TaF_5	276.50	tetrag.
31	nitride	Ta_3N_5	614.54	yel. amor.
32	oxide, di-	TaO_2	213.50	br. powd.
33	oxide, tetra-	Ta_2O_4	427.00	dk. gr.
34	oxide, penta-	Ta_2O_5	443.00	rhombic pr., wh.
35	sulfide	Ta_2S_4	491.26	
36	Tartaric acid	$H_2C_4H_4O_6$	150.05	monocl. pr. wh.
37	Telluric acid	H_2TeO_4	193.52	
38	Telluric acid	$H_2TeO_4.2H_2O$	229.55	reg. octahdr. or monocl. pr.

INORGANIC COMPOUNDS (Continued)

	Sp. Gr. $H_2O = 1$ (A) air = 1 (D) H_2 = 1	Melting-point, Deg. C.	Boiling-point, Deg. C.	Solubility in 100 parts of		
				Cold water	Hot water	Alcohol, acids, etc.
1	1.957	119.3	444.7	i.	i.	s. CS_2, al.
2	2.07	114.5	444.7	i.	i.	$24^{0°}$, $181.3^{35°}$ CS_2
3	$1.709^{0°}_{4}$	−80	138	dec.	dec.	s. CS_2, bz., al. eth.
4	$1.622^{-78°}_{18°}$	−78	59	dec.		
5	.....	−30	d. 20	dec.	dec.	
6	$2.636^{20°}$	−46	$54^{0.18}$ mm.	dec.	dec.	
7	.....	d.	.....	dec.		
8	.....	.....	.....	.....	dec.	s. CS_2
9	.....	−55	−62	al. s.	.....	sl. s. al.; s. KOH
10	(D) $386^{100°}$ 1.655$^{0°}$	d.	.....	dec.	dec.	
11	(A) 2.264, liq. $1.434^{0°}$	−76.1	−10	7979 c.c.$^{0°}$	1560 c.c.$^{60°}$	s. al., H_2SO_4, acet. a.
12	.....	d.	.....	dec.	.....	d. al., eth.
13	(A) 2.75 liq. $1.982^{-5°}_{4°}$	16.8	44.9	dec.	dec.	s. H_2SO_4
14	1.040	50	.....	dec.	dec.	
15	.....	0	d.	dec.	dec.	s. H_2SO_4
16	$1.819^{0°}$	−39	150	dec.	dec.	
17	.....	57	subl.	dec.	dec.	
18	$1.834^{1.90°}_{4}$	10.46	d. 40°	∞	∞	d. al.
19	$1.788^{17°}$	8.53	210–338	∞	∞	d. al.
20	$1.665^{0°}$	−38.9	170–90	∞	∞	d. al.
21	1.89	35	d.	dec.	dec.	d. al.
22	$1.667^{2.0°}_{4}$	.....	69.15	dec.	.....	s. acet. a.
23	.....	−120	−52	.....	10 c.c.$^{90°}$	s. alk.
24	.....	.....	68^{40} mm.	dec.		
25	$1.677^{0°}_{4}$	.....	78	dec.		
26	.....	−110	−30	dec.	dec.	s. eth.
27	16.6	2900	.....	i.	i.	i. HCl, HNO_3, H_2SO_4; s. HF, fus. alk.
28	.....	240	320	dec.	.....	s. abs. al., eth.
29	$3.68^{27°}$	211.3	241.6	dec.	.....	s. H_2SO_4, abs. al.
30	$4.981^{15°}$	94	226	.....	.....	s. HF
31	.....	ign.	.....	i.	.....	i. a.; s. HNO_3 + HF
32	.....	oxidizes	.....	i.	.....	i. a.
33	.....	oxidizes	.....	i.	.....	i. a.
34	7.53	.....	.....	i.	i.	i. a.; s. HF, fus. $KHSO_4$
35	.....	oxidizes				
36	1.755	168–70	.....	$115^{0°}$	$343^{100°}$	$25.6^{15°}$ al.; sl. s. eth.
37	$3.425^{19°}$	d. 160	.....	i.	sl. s.	i. c. a., alk.
38	3.053–.071	$-2H_2O$, 130	.....	$19.7^{0°}$	$258.5^{100°}$	s. a., alk.; i. al.

PHYSICAL CONSTANTS OF

	Name	Formula	Mol. wt.	Crystalline form and color
1	Tellurium	Te	127.50	amor. or rhombic
2	bromide, di-	$TeBr_2$	287.33	steel. gr. need
3	bromide, tetra-	$TeBr_4$	447.16	orange
4	chloride, di-	$TeCl_2$	198.41	blk. cryst
5	chloride, tetra-	$TeCl_4$	269.33	yel. cryst
6	hydride	TeH_2	129.52	gas
7	iodide, di-	TeI_2	381.36	blk. cryst
8	iodide, tetra-	TeI_4	635.23	gr. cryst
9	nitrate	$4TeO_2.N_2O_5.1\frac{1}{2}H_2O$	773.04	ortho rhombic
10	oxide, mon-	TeO	143.50	blk. amor
11	oxidide, di-	TeO_2	159.50	octahdr. yel
12	oxide, tri-	TeO_3	175.50	orange cryst
13	sulfite	$(TeO_2)_2SO_3$	399.06	
14	Tellurous acid	H_2TeO_3	177.52	octahdr. or monocl. pr.
15	Terbium	Tb	159.20	
16	chloride	$TbCl_3$	265.57	need
17	oxide	Tb_2O_3	366.40	amor. orange
18	Thallium	Tl	204.39	bl. wh
19	acetate	$TlC_2H_3O_2$	263.41	silky need
20	bromide, mono-	$TlBr$	284.31	reg
21	bromide, di-	$TlBr_2$	364.22	yel. need
22	bromide, tri-	$TlBr_3$	444.14	yel. need
23	carbonate	Tl_2CO_3	468.78	monocl
24	chlorate	$TlClO_3$	287.85	
25	chloride, mono-	$TlCl$	239.85	reg. wh
26	chloride, sesqui-	Tl_2Cl_3	515.15	yel. hex
27	chloride, tri-	$TlCl_3$	310.76	hex. pl
28	chloride, tri-	$TlCl_3.4H_2O$	382.83	need
29	chloroplatinate	Tl_2PtCl_6	816.75	pa. orange
30	chromate	Tl_2CrO_4	524.79	yel
31	cyanide	$TlCN$	230.40	tabl
32	dichromate	$Tl_2Cr_2O_7$	624.80	red cryst
33	ferrocyanide	$Tl_4Fe(CN)_6.2H_2O$	1065.48	yel. tricl
34	fluoride, mono-	TlF	223.39	reg. octahdr.
35	fluoride, tri-	TlF_3	261.39	olive grn
36	fluosilicate	$Tl_2SiF_6.2H_2O$	586.87	reg. octahdr
37	hydroxide (ous)	$Tl(OH)$	221.40	pr. pa. yel
38	hydroxide (ic)	$TlO.OH$	237.40	yel. cryst
39	hydroxide (ic)	$Tl(OH)_3$	255.41	br. hex
40	iodide, mono-	TlI	331.32	reg. yel
41	iodide, sesqui-	Tl_2I_3	789.58	blk. need
42	iodide, tri-	TlI_3	585.19	br. need
43	nitrate (ous)	$TlNO_3$	266.40	rhombic <72.8°; rh bdr. 72.8-142.5°, > 142.5° reg.

INORGANIC COMPOUNDS (Continued)

	Sp. Gr. $H_2O = 1$ (A) air = 1 (D) H_2 = 1	Melting-point, Deg. C.	Boiling-point, Deg. C.	Solubility in 100 parts of		
				Cold water	Hot water	Alcohol, acids, etc.
1	6.015, 6.25	451	1390	i.	i.	s. H_2SO_4, KCN, HNO_3, aq. reg., KOH; i. CS_2
2	.....	280	339	dec.		
3	$4.31^{15.5°}$	380	420	v. s.		
4	(D) 6.89	175	324	dec.	.....	d. HCl
5	(D) 9.2	214	414	dec.	s.	s. dil. HCl
6	(D) 4.39	−48	0	s.	.....	s. alk.
7	.....	.....	.....	i.	i.	
8	.....	.....	.....	sl. s.	dec.	s. HI
9	.....	.....	.....	dec.	.....	s. HNO_3
0	.....	oxidizes	.....	i.	i.	s. HCl, H_2SO_4
1	$5.89^{0°}$	.....	>700	0.00067	.....	s. a., alk.
2	$5.070^{14.5°}$	d.	.....	i.	i.	i. a.; s. h. KOH
3						
4	3.035–.071	d. 40	.....	sl. s.	dec.	s. a., alk.
5						
6	$4.35^{0°}_{4}$	588				
7	.....	.....	.....	.....	.....	s. a.
8	11.85	301.7	1280	i.	i.	s. HNO_3, H_2SO_4
9	.....	.....	.....	v. s.	.....	v. s. al.
0	$7.54^{22°}$	450	.....	$0.0466^{20°}$	$0.869^{99°}$	
1	.....	.....	.....	dec.	dec.	
2	.....	d.	.....	s.	v. s.	v. s. al.
3	7.06–.16	272	.....	$4.02^{15.5°}$	$27.21^{100°}$	i. a., eth.
4	$5.047^{3°}$	.....	.....	$2.8^{0°}$	$57.3^{100°}$	
5	7.02	426	708–19	$0.2^{0°}$	$1.6^{100°}$	sl. s. HCl; i. a., NH_4OH
6	5.9	400–500	d.	$0.26^{15°}$	$1.9^{100°}$	
7	.....	25°	d.	v. s.		
8	.....	36–7	.....	$86.2^{17°}$	dec.	
9	$5.76^{17°}$	.....	.....	$0.0064^{15°}$	$0.05^{100°}$	
0	.....	.....	.....	$0.03^{60°}$	$0.2^{100°}$	i. acet. a.; sl. s. a., alk.
1	.....	d.	.....	$16.8^{28.5°}$		
2	.....	.....	.....	i.	.....	d. a.
3	4.641	.....	.....	$0.37^{18°}$	$3.93^{101°}$	
4	.....	.....	.....	$80^{15°}$	v. s.	sl. s. al.
5	.....	.....	.....	i.	.....	i. c. HCl
6	.....	.....	.....	v. s.		
7	.....	d. 100	.....	v. s.	v. s.	s. al.
8	.....	$-H_2O$, 115	.....	i.	.....	s. a. NH_4 salts; i. alk.
9	.....	.....	.....	i.	.....	v. s. dil. a.
0	$7.072^{15.5°}$	422	806	$0.0064^{20°}$	$0.125^{100°}$	i. a., KI; s. aq. reg.
1	.....	.....	.....	i.	.....	sl. s. al.
2	.....	.....	.....	.....	.....	s. eth.
3	$5.556^{21.4°}$	205	.....	$3.9^{0°}$, $10.6^{15°}$	$588^{107°}$, $414^{100°}$	i. al.

PHYSICAL CONSTANTS OF

	Name	Formula	Mol. wt.	Crystalline form and color
1	Thallium nitrate (ic)	$Tl(NO_3)_3$	390.41	cryst.
2	oxide (ous)	Tl_2O	424.78	yel.
3	oxide (ic),	Tl_2O_3	456.78	hex. blk.
4	perchlorate	$TlClO_4$	303.85	
5	phosphate	Tl_3PO_4	708.20	need.
6	selenate	Tl_2SeO_4	551.98	pr. need.
7	selenide	Tl_2Se	487.98	leaf.
8	sulfate (ous)	Tl_2SO_4	504.84	rhombic pr.
9	sulfate (ic)	$Tl_2(SO_4)_3.7H_2O$	823.08	leaf.
10	sulfate, acid	$TlHSO_4$	301.46	
11	sulfide (ous)	Tl_2S	440.84	bl. blk. tetrag.
12	sulfide (ic)	Tl_2S_3	504.97	blk. amor.
13	sulfite (ous)	Tl_2SO_3	488.84	cryst.
14	sulfocyanate	TlCNS	262.46	need.
15	Thio-, *see sulfur*			
16	Thorium	Th	232.15	amor. or cryst.
17	boride	ThB_4	275.43	prisms.
18	boride	ThB_6	297.07	amor. violet.
19	bromide	$ThBr_4$	551.81	cryst.
20	carbide	ThC_2	256.15	
21	carbonate	$Th(CO_3)_2$	352.15	
22	chloride	$ThCl_4$	373.98	need.
23	fluoride	$ThF_4.4H_2O$	380.21	cryst.
24	hydroxide	$Th(OH)_4$	300.18	gelat.
25	iodide	ThI_4	539.88	
26	nitrate	$Th(NO_3)_4.12H_2O$	696.37	pl.
27	oxalate	$Th(C_2O_4)_2$	408.15	
28	oxide, di-	ThO_2	264.15	reg.
29	oxide, per-	Th_2O_7	576.30	
30	platinocyanide	$Th[Pt(CN)_4]_2.16H_2O$	1118.93	yel. grn. ortho rhomb.
31	sulfate	$Th(SO_4)_2$	424.28	
32	sulfate	$Th(SO_4)_2.9H_2O$	586.42	monocl.
33	sulfide	ThS_2	296.28	
34	Thulium	Tm	169.40	
35	Tin	Sn	118.70	rhombic
36	Tin	Sn	118.70	wh. tetrag.
37	Tin	Sn	118.70	gray.
38	stannic acid	H_2SnO_3	168.72	amor.
39	stannic acid, meta-	$H_{10}Sn_5O_{15}$	843.58	
40	stannic acid, thio-	H_2SnS_3	216.91	gray.
41	stannic ammonium chloride	$SnCl_4.(NH_4Cl)_2$	367.52	
42	bromide	$SnBr_4$	438.36	

INORGANIC COMPOUNDS (Continued)

	Sp. Gr. $H_2O = 1$ (A) air = 1 (D) H_2 = 1	Melting-point, Deg. C.	Boiling-point, Deg. C.	Solubility in 100 parts of		
				Cold water	Hot water	Alcohol, acids, etc.
1	.....	.....	.....	s.		
2	.....	>870	−O, 1865	v. s.	s.	s. al.
3	$5.56^{0°}$	759	−2O, 875	i.	i.	s. a.; i. alk.
4	4.89	501	d.	$10^{15°}$	$166^{100°}$	
5	$6.89^{100°}$	.....	.....	$0.5^{15°}$	$0.67^{100°}$	i. al.; s. NH_4 salts
6	$7.019^{18°}$	>400	.....	$2.8^{20°}$	$8.5^{80°}$	i. al., eth.
7	.....	340	.....	i.	.....	i. a.
8	6.77	632	d.	$2.7^{0°}$, $5.4^{25°}$	$16.5^{90°}$, $18.5^{100°}$	
9	.....	$-6H_2O$, 200	d.	dec.	.....	s. dil. H_2SO_4
10	.....	115–20				
11	8.0	448	d.	$0.0379^{20°}$	sl. s.	s. a.; i. alk.
12	.....	12	d.	i.	i.	s. H_2SO_4
13	$6.427^{20°}$	.....	.....	$3.34^{15°}$	v. s.	i. al.
14	.....	.....	.....	$0.315^{20°}$	$0.732^{40°}$	i. al.
15						
16	11.00–.23	>1700	.....	i.	i.	s. HCl, H_2SO_4, sl. s. HNO_3, i. alk.
17	$7.5^{15°}$	.....	.....	i.	i.	s. HNO_3, HC
18	$6.4^{15°}$	.....	.....	i.	i.	s. HNO_3, HC
19	5.62	.....	725 in vac.	s.		
20	$8.96^{18°}$	ign.	.....	dec.		
21	.....	.....	.....	i.	dec.	i. CO_2 aq.; s. conc. Na_2CO_3
22	4.59	820	.....	v. s.	v. s.	s. KCl, al., eth.
23	.....	$-H_2O$, 100	$-2H_2O$, 140–200	i.	.....	i. HF
24	.....	dec.	.....	i.	i.	s. a.; i. alk.
25	.....	.....	.....	s.		
26	.....	.....	.....	v. s.	.....	v. s. al.
27	$4.637^{18°}$	d.	.....	i.	.....	s. h. $(NH_4)_2C_2O_4$ aq.
28	$9.876^{15°}$	.....	.....	i.	.....	s. h. H_2SO_4
29	.....	.....	.....	i.		
30	2.460	.....	.....	sl. s.	s.	
31	$4.225^{17°}$	.....	.....	$0.74^{0°}$	$6.76^{55°}$	
32	$2.766^{16°}$	$-9H_2O$, 400	.....	$0.97^{0°}$	$9.41^{55°}$	
33	6.8	.....	.....	i.	i.	sl. s. a.; s. h. aq. reg.
34	.....	.....	.....	i.	i.	
35	6.53–.56	stable >170	2270	i.	i.	s. HCl, H_2SO_4, dil. HNO_3, aq. reg., h. KOH
36	$7.298^{15°}$	232	2270	i.	i.	
37	$5.847^{15°}$	stable <20°	2270	i.	i.	
38	.....	.....	.....	i.	i.	i. a.; s. KOH
39	.....	.....	.....	i.	i.	i. a.; s. KOH
40	.....	.....	.....	i.		
41	.....	.....	.....	s.		
42	$3.349^{25°}$	29.9	203.3	s.	dec.	

	Name	Formula	Mol. wt.	Crystalline form and color
1	stannic chloride	$SnCl_4$	260.53	liq.
2	fluoride	SnF_4	194.70	cryst.
3	iodide	SnI_4	626.43	or.-red octahdr.
4	oxide	SnO_2	150.70	amor., hex., tetrag. or rhombic
5	oxychloride	$SnOCl_2$	205.61	
6	phosphate	$2SnO_2.P_2O_5.10H_2O$	623.61	
7	phosphide	SnP	149.73	
8	selenide	$SnSe_2$	277.10	cryst.
9	sulfate	$Sn(SO_4)_2.2H_2O$	346.86	rhombic
10	sulfide	SnS_2	182.83	hex. yel.
11	stannous bromide	$SnBr_2$	278.53	yel. cryst.
12	chloride	$SnCl_2$	189.61	wh.
13	chloride (tin salt)	$SnCl_2.2H_2O$	225.65	tricl. wh.
14	ferricyanide	$Sn_3[Fe(CN)_6]_2$	779.88	
15	ferrocyanide	$Sn_2Fe(CN)_6$	449.29	
16	fluoride	SnF_2	156.70	prisms.
17	hydroxide	$Sn(OH)_2$	152.72	amor. yel.
18	iodide	SnI_2	372.56	red cryst.
19	oxide	SnO	134.70	blk. reg.
20	oxychloride	$SnO.SnCl_2.6H_2O$	432.41	
21	selenide	$SnSe$	197.90	steel. gr. pr.
22	sulfate	$SnSO_4$	214.76	cryst.
23	sulfide	SnS	150.76	br.
24	telluride	$SnTe$	246.20	gr. cryst.
25	Titanic acid	H_2TiO_3	98.12	
26	Titanium	Ti	48.10	amor. dk. gr.
27	bromide, tetra-	$TiBr_4$	367.76	orange cryst.
28	chloride, di-	$TiCl_2$	119.01	blk.
29	chloride, tri-	$TiCl_3$	154.47	dk. violet
30	chloride, tetra-	$TiCl_4$	189.93	
31	cyanide	$Ti_5(CN)_4$	344.53	red. octahdr.
32	fluoride, tri-	TiF_3	105.10	purp. red
33	fluoride, tetra-	TiF_4	124.10	
34	iodide, tetra-	TiI_4	555.83	octahdr. red.
35	nitrate	$5TiO_2.N_2O_5.6H_2O$	616.61	pl.
36	oxalate	$Ti_2(C_2O_4)_3.10H_2O$	540.36	yel. pr.
37	oxide, sesqui-	Ti_2O_3	144.20	blk. amor.
38	oxide, di-	TiO_2	80.10	tetrag. wh. to blk.
39	oxide, per-	TiO_3	96.10	yel.

INORGANIC COMPOUNDS (Continued)

	Sp. Gr. $H_2O = 1$ (A) air = 1 (D) H_2 = 1	Melting-point, Deg. C.	Boiling-point, Deg. C.	Solubility in 100 parts of		
				Cold water	Hot water	Alcohol, acids, etc.
1	2.279$^{0°}$	−33	114	s.	dec.	s. al., CS_2, oil turp.
2	4.780$^{1.3°}$	.....	705	v. s. hyg.	d. to SnO_2	
3	4.696$^{11°}$	144	295	v. s.	dec.	145$^{15°}$ CS_2; s. al., eth.
4	6.60–.85	1127	.....	i.	i.	s. H_2SO_4
5	.....	.....	.....	s.		
6	anh. 3.98	.....	.....	i.	i.	i. HNO_3
7	6.56	.....	.....	i.	.....	s. HCl; i. HNO_3
8	4.85	.....	.....	i.	.....	i. dil. a.; s. alk., h. H_2SO_4
9	.....	.....	.....	v. s.	dec.	s. dil. H_2SO_4, HCl
10	4.42–.60	d.	.....	0.00002	i.	s. HCl, alk. sulfides
11	5.117$^{17°}$	215	617–34	s.	dec.	
12	.....	247.2	603–28	83.9$^{0°}$	269.8$^{15°}$	s. alk., al., tart. a.
13	2.71$^{15.5°}$	37.7	d.	118.7$^{0°}$	∞	
14	.....	.....	.....	i.	.....	s. HCl
15	.....	.....	.....	i.	.....	s. h. HCl
16	.....	.....	.....	v. s.		
17	.....	.....	.....	i.	dec.	s. dil. a., alk.; i. NH_4OH
18	.....	316	720	0.98$^{20°}$	4.03$^{100°}$	s. dil. HCl, KOH
19	6.3	d.	.....	i.	i.	s. a., NH_4Cl; i. alk.
20	.....	.....	.....	i.	i.	s. dil. a., al.
21	6.179$^{0°}$	.....	.....	i.	.....	s. alk. sulfides
22	.....	−SO_2, 360	.....	18.9$^{13°}$	18.2$^{100°}$	s. H_2SO_4
23	5.27$^{15°}$	882	1230	0.000002	.....	s. HCl, $(NH_4)_2Sx$
24	6.478$^{0°}$	.....	.....	.....	.....	i. HCl
25	.....	.....	.....	i.	i.	i. al.; s. a., alk.
26	4.50$^{17.5}$	1795	.....	i.	dec.	s. a.
27	2.6	39	230	dec.	.....	.....
28	.....	.....	.....	dec.	.....	i. CS_2, eth., chl.
29	.....	d. 440	.....	s.	s.	v. s. al.; i. eth.
30	1.76$^{0°}_{4}$	−25	136.4	dec.	.....	s. dil. HCl
31	5.28	.....	.....	i.	i.	i. a.; s. HNO_3 + HF
32	.....	.....	.....	s.		
33	2.798$^{20.5°}$	284–87	>400	dec.	.....	i. eth.; s. H_2SO_4
34	.....	150	>360	v. s.	v. s.	
35	.....	.....	.....	s.		
36	.....	.....	.....	s.	s.	i. al., eth.
37	.....	oxidizes	.....	i.	i.	s. H_2SO_4, HF
38	3.75–4.25	1560	.....	i.	i.	s. H_2SO_4, alk.
39	.....	.....	.....	.....	.....	s. a.

PHYSICAL CONSTANTS OF

	Name	Formula	Mol. wt.	Crystalline form and color
1	Titanium sulfate	$Ti_2(SO_4)_3$	384.39	grn. cryst
2	Tungsten	W	184.00	gr. to blk,
3	bromide, di-	WBr_2	343.83	bl. blk
4	bromide, penta-	WBr_5	583.58	violet- br. need
5	carbide	W_2C	380.00	
6	chloride, di-	WCl_2	254.91	gray, amor
7	chloride, tetra-	WCl_4	325.83	gray cryst
8	chloride, penta-	WCl_5	361.29	blk. need
9	chloride, hexa-	WCl_6	396.74	dk. bl. reg
10	dioxydibromide	WO_2Br_2	375.83	red pr
11	dioxydichloride	WO_2Cl_2	286.91	yel. tabl
12	iodide	WI_2	437.86	grn
13	oxide, di-	WO_2	216.00	rhombic br
14	oxide, tri-	WO_3	232.00	rhombic yel
15	oxytetrabromide	$WOBr_4$	519.66	blk. need
16	oxytetrachloride	$WOCl_4$	341.83	red need
17	phosphide	W_2P	399.03	dk. gr. prisms
18	phosphide	WP	215.03	gr. prisms
19	phosphide	WP_2	246.05	blk. cryst
20	sulfide, di-	WS_2	248.13	dk. gr. cryst
21	sulfide, tri-	WS_3	280.19	blk. powd
22	Tungstic acid	H_2WO_4	150.02	yel
23	Tungstic acid, meta-	$H_2W_4O_{13}$	946.02	yel. octahdr
24	Uranic acid	H_2UO_4	304.19	yel. powd
25	Uranium	U	238.17	wh. cryst
26	bromide, tri-	UBr_3	477.92	dk. br. need
27	bromide, tetra-	UBr_4	557.83	blk. leaf
28	carbide	U_2C_3	512.34	cryst
29	chloride, tri-	UCl_3	344.54	br.-red
30	chloride, tetra-	UCl_4	380.00	dk. grn. reg
31	chloride, penta-	UCl_5	415.46	dk. need
32	fluoride, tetra-	UF_4	314.17	grn. powd
33	fluoride, hexa-	UF_6	352.17	yel. monocl
34	iodide, tetra-	UI_4	745.90	need
35	oxide, di-	UO_2	270.17	blk. octahdr
36	oxide (ous, ic)	U_3O_8	842.51	olive grn

INORGANIC COMPOUNDS (Continued)

	Sp. Gr. $H_2O = 1$ (A) air = 1 (D) H_2 = 1	Melting-point, Deg. C.	Boiling-point, Deg. C.	Solubility in 100 parts of		
				Cold water	Hot water	Alcohol, acids, etc.
1	.....	.....	.....	i.	i.	s. dil. a.; i. al., eth.
2	18.7	3400	5830	i.	i.	s. HNO_3, aq. reg., conc. h. KOH
3	.....	d. 400	.....	dec.		
4	.....	276	333	dec.	.....	s. alk.
5	$16.08^{18°}$	.....	.....	i.	.....	sl. s. HCl, H_2SO_4; s. HNO_3
6	.....	.....	.....	dec.		
7	.....	d.	.....	dec.		
8	.....	248	275.6	dec.	.....	sl. s. CS_2
9	(D) $13.3^{359°}$	275	346.7	.....	d. 80°	v. s. CS_2, $POCl_3$
10	.....	.....	d.			
11	.....	266	.....	s.	dec.	s. alk., NH_4OH
12	$6.9^{18°}$					
13	12.11	.....	.....	i.	i.	s. a., KOH
14	7.16	.....	.....	i.	i.	i. a.; s. alk.
15	.....	277	327	dec.		
16	.....	208–10	227.5	.....	.....	s. CS_2
17	5.207	.....	.....	.....	.....	i. a.; s. fus. Na_2CO_3 + $NaNO_3$
18	8.5	.....	.....	i.	.....	i. alk., HCl; s. HNO_3 + HF
19	5.8	d.	.....	i.	i.	i. al.; eth. s. HNO_3 + HF
20	$7.5^{40°}$	.....	.....	.....	.....	oxidized by HNO_3
21	.....	.....	.....	sl. s.	s.	s. alk. sulf. alk.
22	.....	$-\frac{1}{2}H_2O$, 100	.....	i.	sl. s.	s. alk.
23	.....	.....	.....	s.		
24	$5.93^{15°}$	$-H_2O$, 250–300	.....	i.	i.	s. a., alk. carb.; i. alk.
25	$18.685^{14}_{4}{}^{0°}$	<1850	ign.	i.	i.	s. a.; i. alk.
26	.....	.....	v. volt.	s.		
27	$4.838^{2}_{4}{}^{0°}$	.....	volt.	s.	s.	
28	$11.28^{18°}$	.....	.....	dec.	dec.	s. a.
29	.....	.....	.....	v. s.		
30	.....	.....	.....	v. s.	dec.	s. NH_4Cl
31	.....	d. 120	.....	dec.		
32	.....	1000	.....	i.	.....	i. dil. a.; s. conc. a.
33	$4.68^{20.7°}$	69.5^{2} atm.	.....	s.	.....	s. CCl_4, chl.: i. CS_2
34	$5.6^{15°}$	500	.....	s.	s.	
35	10.95	2176	.....	i.	i.	s. HNO_3, H_2SO_4
36	7.31	d.	.....	i.	i.	s. HNO_3, H_2SO_4

	Name	Formula	Mol. wt.	Crystalline form and color
1	Uranium oxide, tri-	UO_3	286.17	yel. powd.
2	oxide, per-	$UO_4.2H_2O$	338.20	yel. cryst.
3	sulfate, (ous)	$U(SO_4)_2.4H_2O$	502.36	grn. monocl.
4	sulfide, di-	US_2	302.30	gr.
5	sulfide, sesqui-	U_2S_3	572.53	gr. blk.
6	Uranyl acetate	$UO_2(C_2H_3O_2)_2.2H_2O$	424.25	yel. monocl.
7	ammonium carbonate	$UO_2CO_3.2(NH_4)_2CO_3$	522.33	yel. cryst.
8	chloride	UO_2Cl_2	341.08	yel. cryst.
9	iodate	$UO_2(IO_3)_2.H_2O$	638.05	
10	nitrate	$UO_2(NO_3)_2.6H_2O$	502.28	rhombic yel.
11	phosphate	$UO_2(HPO_4)_2.4H_2O$	534.30	rhombic yel
12	potassium carbonate	$UO_2CO_3.2K_2CO_3$	606.55	yel. cryst
13	sodium carbonate	$UO_2CO_3.2Na_2CO_3$	542.16	yel. cryst
14	sulfate	$UO_2SO_4.3H_2O$	420.28	yel. cryst
15	sulfide	UO_2S	302.23	br.
16	Vanadic acid, meta-	HVO_3	99.97	yel. scales
17	Vanadic acid, pyro-	$H_4V_2O_7$	217.95	amor. br.
18	Vanadium	V	50.96	lt. gr. cryst.
19	bromide, tri-	VBr_3	290.71	gr. blk. amor
20	carbide	VC	62.96	
21	chloride, di-	VCl_2	121.87	grn. hex.
22	chloride, tri-	VCl_3	157.33	pink
23	chloride, tetra-	VCl_4	192.79	red liq.
24	fluoride, tri-	VF_3	107.96	grn.
25	fluoride, tri-	$VF_3.3H_2O$	162.01	rhbdr.
26	fluoride, tetra-	VF_4	126.96	yel.
27	fluoride, penta-	VF_5	145.96	
28	oxide, di-	V_2O_2	133.92	lt. gr. cryst.
29	oxide, tri-	V_2O_3	149.92	blk. cryst
30	oxide, tetra-	V_2O_4	165.92	bl. cryst.
31	oxide, penta-	V_2O_5	181.92	yel.-red rhombic
32	oxydibromide	$VOBr_2$	226.79	br.
33	oxytribromide	$VOBr_3$	306.71	red. liq.
34	oxymonochloride	VOCl	102.42	br. powd.
35	dioxymonochloride	V_2O_2Cl	169.38	yel. cryst.
36	oxydichloride	$VOCl_2$	137.84	grn. tabl.
37	oxytrichloride	$VOCl_3$	173.33	yel. liq.
38	silicide	VSi_2	107.08	met. prisms
39	silicide	V_2Si	129.98	silv. prisms
40	sulfide, di-	V_2S_2	166.05	blk. pl.
41	sulfide, tri-	V_2S_3	198.11	dk. pl.

INORGANIC COMPOUNDS (Continued)

	Sp. Gr. $H_2O = 1$ (A) air = 1 (D) $H_2 = 1$	Melting-point, Deg. C.	Boiling-point, Deg. C.	Solubility in 100 parts of		
				Cold water	Hot water	Alcohol, acids, etc.
1	5.02–.26	d.	.....	i.		
2	.....	.....	.....	hyg.	.....	d. HCl
3	.....	$-4H_2O$, 300	.....	dec.	.....	s. dil. a.
4	.....	>1100	oxidizes	dec.		s. HCl
5	.....	ign.	.....	.....	.....	sl. s. HCl; s HNO_3
6	.....	$-2H_2O$, 275	.....	s.	dec.	s. al.
7	.....	d.	.....	$5^{15°}$	dec.	s. $(NH_4)_2CO_3$, SO_2 aq.
8	.....	.....	d.	$320^{18°}$	s.	s. al., eth.
9	$5.052^{18°}$	.....	.....	$0.1214^{18°}$		
10	2.807	60	118	200	v. s.	v. s. al., eth., acet. a.
11	.....	.....	.....	i.	i.	i. acet. a.
12	.....	$-CO_2$, 300	.....	$7.4^{15°}$	dec.	i. al.
13	.....	.....	.....	s.	.....	i. al.
14	$3.280^{16.5°}$	.....	.....	$16.6^{13°}$	$22.2^{100°}$	4 al.; s. H_2SO_4
15	.....	d. 40–50	.....	sl. s.	.....	s. al., HCl
16	.....	.....	.....	sl. s.	s.	i. al.; s. alk., NH_4OH
17	.....	.....	.....	sl. s.	s.	i. al.; s. NH_4OH
18	$6.025^{15°}_{15°}$	1720	.....	i.	i.	s. HNO_3, HF, H_2SO_4
19	.....	oxidizes	.....	s.		
20	5.36	.....	.....	.....	.....	s. HNO_3
21	$3.23^{18°}$	.....	.....	s.	s.	s. al., eth.
22	$3.00^{18°}$	.....	.....	s.	s.	s. abs. al., eth.
23	$1.8659^{0°}$	<−18	154	s.	s.	s. abs. al., eth.
24	$3.363^{19°}$	>800	subl.	i.	.....	i. al., chl., CS_2
25	.....	$-3H_2O$, 130	.....	s.	v. s.	i. abs. al.
26	$2.975^{23°}$	d. 325	.....	s.	.....	s. acet.; sl. s. a., chl.
27	$2.177^{19°}$	.....	111.2	s.	.....	s. al., chl.: i. CS_2
28	3.64	ign.	.....	i.	i.	s. a.
29	$4.87\frac{8°}{4°}$	.....	.....	sl. s.	s.	s. HF, HCl, h. H_2SO_4
30	.....	.....	.....	i.	i.	s. a., alk.
31	$3.357\frac{18°}{4°}$	658	.....	$0.8^{20°}$	.....	s. a., alk.
32	.....	d. 180	.....	s.		
33	$2.933^{14.5°}$	130–6	d. 180	s.		
34	.....	.....	.....	i.	.....	v. s. HNO_3
35	.....	.....	.....	i.	.....	s. HNO_3
36	$2.88^{13°}$	.....	.....	d.	.....	s. dil. HNO_3
37	$1.836^{17.5°}$	<−15	127.19	v. s.	.....	s. al.
38	4.42	.....	.....	i.	i.	i. al., eth., bz., a.; s. HF
39	.....	.....	.....	i.	i.	
40	4.2–.4	oxidizes	.....	.....	.....	s. h. H_2SO_4 HNO_3
41	3.7–4.0	oxidizes	.....	.....	.....	s. alk. sulf., alk.

	Name	Formula	Mol. wt.	Crystalline form and color
1	Vanadium sulfide, penta-	V_2S_5	262.24	blk.
2	Vanadyl sulfate	$(VO)_2(SO_4)_3$	422.11	blue.
3	Water	H_2O	18.02	colorl. liq.
4	Xenon	Xe	130.20	colorl. gas
5	Ytterbium	Yb	173.60	
6	acetate	$Yb(C_2H_3O_2)_3.2H_2O$	386.70	hex. pl.
7	chloride	$YbCl_3.6H_2O$	388.07	rhombic grn.
8	oxalate	$Yb_2(C_2O_4)_3.10H_2O$	791.36	cryst.
9	oxide	Yb_2O_3	395.20	
10	oxide	$Yb_2O_3.6H_2O$	503.30	gelat.
11	selenate	$Yb_2(SeO_4)_3.8H_2O$	920.93	hex. pl.
12	selenite	$Yb_2(SeO_3)_3$	728.80	
13	sulfate	$Yb_2(SO_4)_3$	635.39	
14	sulfate	$Yb_2(SO_4)_3.8H_2O$	779.52	prisms
15	Yttrium	Y	88.90	hex. gr. blk.
16	bromate	$Y(BrO_3)_3.9H_2O$	634.79	hex. pr.
17	bromide	YBr_3	328.65	
18	bromide	$YBr_3.9H_2O$	490.79	tabl.
19	carbonate	$Y_2(CO_3)_3.3H_2O$	411.85	
20	chloride	YCl_3	195.27	pl.
21	chloride	$YCl_3.6H_2O$	303.37	rhombic prisms
22	fluoride	$YF_3.\frac{1}{2}H_2O$	154.91	gelat.
23	hydroxide	$Y(OH)_3$	139.92	gelat.
24	iodide	YI_3	469.70	
25	nitrate	$Y(NO_3)_3.4H_2O$	346.99	prisms
26	nitrate	$Y(NO_3)_3.6H_2O$	383.02	cryst.
27	oxalate	$Y_2(C_2O_4)_3.9H_2O$	603.94	
28	oxide	Y_2O_3	225.80	cryst.
29	sulfate	$Y_2(SO_4)_3$	465.99	
30	sulfate	$Y_2(SO_4)_3.8H_2O$	610.12	monocl.
31	Zinc	Zn	65.38	cryst. silvery
32	acetate	$Zn(C_2H_3O_2)_2$	183.43	monocl.-lvs.
33	acetate	$Zn(C_2H_3O_2)_2.3H_2O$	237.48	wh. monocl. pl.
34	amide	$Zn(NH_2)_2$	97.43	amor.
35	ammonium sulfate	$ZnSO_4.(NH_4)_2SO_4.6H_2O$	401.68	
36	arsenate	$Zn_3(AsO_4)_2.8H_2O$	618.19	monocl. need.
37	bromate	$Zn(BrO_3)_2.6H_2O$	429.31	reg.
38	bromide	$ZnBr_2$	225.21	need.
39	carbonate	$ZnCO_3$	125.38	rhbdr.
40	chlorate	$Zn(ClO_3)_2.6H_2O$	340.39	

INORGANIC COMPOUNDS (Continued)

	Sp. Gr. $H_2O = 1$ (A) air = 1 (D) H_2 = 1	Melting-point, Deg. C.	Boiling-point, Deg. C.	Solubility in 100 parts of		
				Cold water	Hot water	Alcohol, acids, etc.
1	3.0	oxidizes	.....	.....	.....	s. alk. sulf., alk.
2	.....	.....	.....	v. s.	dec.	s. al.
3	$1.00^{4°}$	0	100	.....	.....	∞ al.
4	(D) 63.5 (A) 4.422	−140	−109.1	28.4 c.c.$^{17°}$		
5	.....	1890				
6	2.09	−4H_2O, 100	.....	v. s.	v. s.	
7	2.575	150–5	−6H_2O, 180	v. s.	v. s.	s. abs. al.
8	2.644	.....	.....	0.000583	.....	sl. s. dil. a.
9	9.175	.....	.....	i.	i.	s. h. dil. a.
10	.....	.....	.....	i.	.....	v. s. a., KOH; i. NH_4OH
11	3.49	.....	.....	s.		
12	.....	.....	.....	i.		
13	3.62	d. 900	.....	$44.2^{20°}$	$4.67^{100°}$	
14	$3.286^{20.5°}$	.....	.....	s.		
15	$3.80^{15°}$	1490	.....	sl. dec.	dec.	v. s. dil. a., h. KOH
16	.....	780	−6H_2O, 100	158		
17	.....	.....	.....	v. s.	.....	s. al.; i. eth.
18	.....	.....	.....	v. s.		s. al.; i. eth.
19	.....	.....	.....	i.	.....	sl. s. CO_2 aq.; s. $(NH_4)_2CO_3$ aq.
20	$2.81^{18°}$	160	.....	v. s.		
21	$2.18^{18°}$	d. 100	.....	v. s.	v. s.	s. al.; i. eth.
22	.....	.....	.....	i.	.....	sl. s. a.
23	.....	d.	.....	i.	i.	i. alk.; s. a., NH_4Cl
24	.....	.....	.....	v. s.	.....	s. al.; sl. s. eth.
25	2.682	.....	.....	s.	.....	s. HNO_3
26	.....	d.	.....	v. s.	.....	v. s. al., eth.
27	.....	d.	.....	0.000137	.....	sl. s. HCl
28	$5.35^{18°}$	.....	.....	i.	i.	s. a.; i. alk.
29	2.612	d. 1000	.....	1.52	sl. s.	s. sat. K_2SO_4 aq.
30	2.558	−8H_2O, 450	.....	9.3	$4.8^{100°}$	s. sl. s. H_2SO_4; i. al.
31	$7.142^{16°}$	419.4	930	i.	i.	s. a., alk., acet. a.
32	1.84	242	subl. in vac.	$30^{25°}$	$44.6^{100°}$	$2.8^{25°}$, $166^{79°}$ al.
33	1.72	235–57	−3H_2O, 100	$40^{25°}$	$66.6^{100°}$	
34	.....	d.	.....	dec.	.....	d. al.; i. eth.
35	.....	.....	.....	$7^{0°}$	$42^{80°}$	
36	$3.309^{15°}$	.....	.....	i.	.....	s. HNO_3, H_3AsO_4, alk.
37	2.566	100	−6H_2O, 200	100	v. s.	
38	$4.219^{2°}_{4°}$	394	650	$390^{0°}$	$670^{100°}$	v. s. al., eth., NH_4OH
39	4.42–.45	−CO_2, 300	.....	$0.001^{15°}$	.....	s. a., alk., NH_4 salts
40	.....	60	d.	$652^{0°}$	∞	v. s. al.

	Name	Formula	Mol. wt.	Crystalline form and color
1	Zinc chloride	$ZnCl_2$	136.29	octahdr. or pr. wh.
2	cyanide	$Zn(CN)_2$	117.40	ortho-rhombic pr.
3	ferrocyanide	$Zn_2Fe(CN)_6.3H_2O$	396.70	wh. powd.
4	fluoride	ZnF_2	103.38	monocl. need.
5	fluoride	$ZnF_2.4H_2O$	175.44	
6	hydroxide	$Zn(OH)_2$	99.40	rhombic pr.
7	iodate	$Zn(IO_3)_2.2H_2O$	451.28	
8	iodide	ZnI_2	319.24	octahdr.
9	nitrate	$Zn(NO_3)_2.6H_2O$	297.49	tetrag.
10	nitride	Zn_3N_2	224.16	gray.
11	oxalate	$ZnC_2O_4.2H_2O$	189.41	wh. powd.
12	oxide	ZnO	81.38	wh. hex. or amor.
13	oxide, per-	ZnO_2	97.38	yel.
14	oxysulfide	$ZnO.ZnS$	178.82	yel.
15	permanganate	$Zn(MnO_4)_2.6H_2O$	411.34	dk. bl. cryst.
16	phosphate	$Zn_3(PO_4)_2$	386.19	pr.
17	phosphate	$Zn_3(PO_4)_2.4H_2O$	458.26	pr.
18	phosphate	$Zn_3(PO_4)_2.8H_2O$	530.32	rhombic pl.
19	phosphate, acid	$ZnH_4P_2O_8.2H_2O$	295.50	tricl.
20	phosphate, pyro-	$Zn_2P_2O_7$	304.81	
21	phosphide	Zn_3P_2	258.19	octahdr.
22	salicylate	$Zn(C_7H_5O_3)_2.3H_2O$	393.51	need.
23	silicate	$ZnSiO_3$	141.44	hex. pr.
24	sulfate	$ZnSO_4$	161.44	hex. pr.
25	sulfate	$ZnSO_4.6H_2O$	269.54	monocl. or tetrag.
26	sulfate	$ZnSO_4.7H_2O$	287.56	rhombic or monocl.
27	sulfide	ZnS	97.44	yel. reg. tetrahdr. or hex. rhbdr.
28	sulfide (blende)	ZnS	97.44	gr.
29	sulfite	$ZnSO_3.2\frac{1}{2}H_2O$	190.48	
30	Zirconium	Zr	91.00	cryst. / amor.
31	bromide	$ZrBr_4$	410.66	cryst. powd.
32	carbide	ZrC_2	115.00	
33	chloride	$ZrCl_4$	232.83	
34	fluoride	ZrF_4	167.00	hex.
35	hydroxide	$Zr(OH)_4$	159.03	gelat.
36	iodide	ZrI_4	598.73	red br. cryst.

INORGANIC COMPOUNDS (Continued)

	Sp. Gr. $H_2O = 1$ (A) air = 1 (D) $H_2 = 1$	Melting-point, Deg. C.	Boiling-point, Deg. C.	Solubility in 100 parts of		
				Cold water	Hot water	Alcohol, acids, etc.
1	$2.907^{\frac{25}{4}^{5°}}$	365	730	$209^{0°}$	$616^{100°}$	$100^{12.5°}$ al.; v. s. eth.
2	.....	d.	.....	i.	i.	i. al.; s. alk., KCN
3	.....	.....	.....	i.	i.	i. HCl; s NH_4OH
4	$4.612^{12°}$	734	.....	sl. s.	s.	i. al.; s. h. a.
5	$2.535^{12°}$	$-4H_2O$, 100	.....	$1.6^{18°}$	s.	s. NH_4OH, a., alk.
6	3.053	d.	.....	$0.0004^{18°}$	i.	s. a., alk.
7	. .....	.....	.....	0.877	1.32	s. HNO_3, NH_4OH, alk.
8	4.696	446	624	$430^{0°}$	$510^{100°}$	s. a., $(NH_4)_2CO_3$ aq.
9	$2.065^{13°}$	36.4	$-6H_2O$, 105 131	$324.5^{0°}$	∞	v. s. al.
10	.....	.....	.....	dec.		
11	anh..... $2.582^{17.5°}$	.....	.....	$0.0007^{918°}$	.....	s. a., alk.
12	5.42–.78	.....	.....	0.001	.....	s. a., alk., NH_4Cl
13	.....	.....	.....	i.	.....	d. a.
14	.....	.....	.....	.....	.....	s. HCl
15	.....	$-5H_2O$, 100	.....	v. s.	v. s.	d. al., a.
16	$3.998^{15°}$	.....	.....	i.	i.	s. a.
17	2.76–.85	.....	.....	i.	.....	v. s. a., NH_4OH, NH_4 salts
18	$3.109^{15°}$	.....	.....	i.	.....	s. alk.
19	.....	.....	.....	dec.		
20	.....	.....	.....	i.	i.	s. a., alk., NH_4OH
21	$4.55^{13°}$	.....	.....	i.	.....	s. dil. a.
22	.....	.....	.....	$5^{20°}$	.....	s. al.
23	$3.52^{\frac{25}{4}^{5°}}$	1437	.....	i.		
24	$3.624^{15°}$	d. 720	.....	$43.02^{0°}$	$95.03^{100°}$	sl. s. al.
25	2.07	.....	.....	s.		
26	$1.966^{16.5°}$	$-7H_2O$, 380	.....	$115.2^{0°}$	$633.59^{100°}$	sl. s. al.
27	3.98	1049	subl. 1180	0.00065	i.	v. s. a.; i. acet. a.
28	4.03–.07	1049	subl. 1180	0.00065	i.	v. s. a.; i. acet. a.
29	.....	.....	.....	0.16	dec.	i. al.; s. H_2SO_3, NH_4OH
30	$6.40^{18°}$ 4.15	2350 1500	.....	i.	i.	s. HF; sl. s. a.
31	.....	.....	.....	dec.		
32	.....	.....	.....	.....	.....	s. dil. HF
33	.....	.....	400	s.	dec.	s. al.
34	$4.433^{16°}$	.....	.....	1.388	dec.	s. HF
35	3.25	$-2H_2O$, 550	.....	0.02	i.	s. a.; i. alk., al.
36	.....	.....	.....	s.	s.	s. a., eth.; sl. s. CS_2

PHYSICAL CONSTANTS OF

	Name	Formula	Mol. wt.	Crystalline form and color
1	Zirconium nitrate	$Zr(NO_3)_4.5H_2O$	429.11	
2	oxalate	$Zr(C_2O_4)_2.2Zr(OH)_4$	585.06	
3	oxide, di-	ZrO_2	123.00	amor. or hex.
4	oxide, per-	ZrO_3	139.00	
5	oxybromide	$ZrOBr_2.3H_2O$	320.88	need
6	oxychloride	$ZrOCl_2.8H_2O$	322.04	need
7	oxyiodide	$ZrI(OH)_3.3H_2O$	323.00	amor.
8	oxyiodide	$ZrI_2O.8H_2O$	504.99	need
9	sulfate	$Zr(SO_4)_2.4H_2O$	355.19	cryst.

INORGANIC COMPOUNDS (Continued)

	Sp. Gr. $H_2O = 1$ (A) air = 1 (D) H_2 = 1	Melting-point, Deg. C.	Boiling-point, Deg. C.	Solubility in 100 parts of		
				Cold water	Hot water	Alcohol, acids, etc.
1	.....	d. 100	.....	s.	dec.	
2	.....	d.	.....	i.	.....	s. $(NH_4)_2C_2O_4$
3	$5.482^{15.5°}$	2500	.....	i.	i.	s. H_2SO_4, HF
4	.....	.....	.....	.....	.....	i. c. dil. H_2SO_4
5	.....	.....	.....	s.		
6	.....	.....	.....	s.	dec.	s. al.
7	.....	.....	.....	v. s.		
8	.....	d.	.....	v. s.	v. s.	v. s. eth.
9	.....	.....	.....	s.	$146^{39.5°}$	s. H_2SO_4; i. al

PHYSICAL CONSTANTS OF

The following table contains data for over three thousand compounds. The information has been collected from a large number of sources including not only the standard reference works but many modern texts on organic chemistry and on special branches of the subject.

Specific gravities are given at 15° C. where no other temperature is indicated, or at the definite temperature shown by the small figures at the right.

Boiling-points are given at normal atmospheric pressure unless otherwise indicated. Decomposition, occurring near or below the melting or boiling point is indicated by the letter d., preceding the temperature when decomposition occurs before the change of state and following the temperature when decomposition occurs with the change of state: d. 178 indicates that decomposition occurs at 178° C.; 178, d. indicates that the substance changes state with decomposition at 178° C.

Solubilities are indicated by figures giving the mass in grams soluble in 100 c.c. of the solvents. Unless otherwise indicated solubilities under alcohol are for 95% ethyl alcohol.

No.	Name	Synonyms	Formula	Mol. wt.
1	Abietic acid		$C_{20}H_{30}O_2$	302.24
2	Acenaphthene		$C_{10}H_6(CH_2)_2$	154.08
3	Acetal		$CH_3 \cdot CH(OC_2H_5)_2$	118.11
4	Acetaldehyde	aldehyde	CH_3CHO	44.03
5	Acetaldehyde-semicarbazone		$CH_3CH : N \cdot NH \cdot CO \cdot NH_2$	101.08
6	Acetaldoxime	aldoxime	$CH_3 \cdot CH : NOH$	59.05
7	Acetamide		$CH_3 \cdot CO \cdot NH_2$	59.05
8	Acetamidine		$CH_3 \cdot C(NH)NH_2$	58.06
9	Acetamino-naphthol (1, 2)		$CH_3CO \cdot NH \cdot C_{10}H_6 \cdot OH$	201.10
10	Acetamino-naphthol (4, 1)	naphthacetol	$CH_3CO \cdot NH \cdot C_{10}H_6 \cdot OH$	201.10
11	Acetamino-phenol (2, 1)		$CH_3CO \cdot NH \cdot C_6H_4 \cdot OH$	151.08
12	" " (3, 1)		$CH_3CO \cdot NH \cdot C_6H_4 \cdot OH$	151.08
13	" " (4, 1)		$CH_3CO \cdot NH \cdot C_6H_4 \cdot OH$	151.08
14	Acetanilide	antifebrin	$C_6H_5 \cdot NH \cdot CO \cdot CH_3$	135.08
15	Acetaniside (o.)		$CH_3O \cdot C_6H_4 \cdot NH \cdot COCH_3$	165.10
16	Acetbromamide		$C_2H_3O \cdot NHBr$	137.96
17	Acetcinnamone		$C_6H_5 \cdot C_2H_2 \cdot CO \cdot CH_3$	146.08
18	Acetic acid		$CH_3 \cdot COOH$	60.03
19	anhydride		$(CH_3CO)_2O$	102.05
20	Acetnaphthalide (1)	acetalphanaphthylamine	$C_{10}H_7 \cdot NH \cdot COCH_3$	185.10
21	" (2)	acet-betanaphthylamine	$C_{10}H_7 \cdot NH \cdot COCH_3$	185.10
22	Acetoacetanilide		$CH_3 \cdot CO \cdot CH_2 \cdot CO \cdot NH \cdot C_6H_5$	177.10
23	Acetoethylnitrate		$C_2H_4O(C_2H_5 \cdot NO_3)_2$	226.13

ORGANIC COMPOUNDS

The following abbreviations are used: — a., acid; abs., absolute; abt., about; acet., acetone; acet. a., acetic acid; al., alcohol; alk., alkali; amor., amorphous; anh., anhydrous; br., brown; bz., benzene; c., cold; chl., chloroform; colorl., colorless; cryst., crystals; d., under melting-points, boiling-points or solubilities, decomposes; d., in connection with the names of compounds, dextrorotary; dec., decomposes; dil., dilute; dk., dark; deliq., deliquescent; eth., ether; exp., explodes; f., from; feath., feathery; fluores., fluorescent; glac., glacial; glit., glittering; grn., green; h., hot; hex., hexagonal; i., insoluble; ign., ignites; l., laevo-rotary; leaf, leaflets; liq., liquid; lgr., ligroin; lng., long; lust., lustrous; m., meta-; meth., methyl; mic., microscopic; min., mineral; monocl., monoclinic; m.p., melting-point; n., normal; need., needles; o., ortho-; octahdr., octahedral; p., para-; pa., pale; pl., plates; powd., powder; pr., prisms; purp., purple; pyr., pyridine; rac., racemic; rhomb., rhombic; rhbdr., rhombohedral; s., soluble; sc., scales; sl., slightly; sm., small; subl., sublimes; sym., symmetrical; tab., tablets; tetr., tetragonal; tricl., triclinic; trim., trimetric; uns., unsymmetrical; v., very; visc., viscous; w., water; wh., white; yel., yellow; >, above; <, below; ∞, soluble in all proportions.

No.	Crystalline form and color	Sp. gr. H_2O = 1 (A)Air = 1	Melting-point °C	Boiling-point °C	Solubility in gms. per 100 c.c. of		
					Water	Alcohol	Ether
1	leaf.	.....	182	.....	i.	v. s.	v. s.
2	need.	1.0687	95	277.5	.....	s. h.	.....
3	liq.	$0.8314^{20°}$	.....	104	5.5 c.	∞	∞
4	liq.	$0.806^{0°}$	−120.7	20.8	∞	∞	∞
5	cryst.	$1.0300^{0°}$	162	.....	.....	.....	.....
6	liq. or need.	$0.965^{20°}$	13 or 47	115	∞	∞	∞
7	need. f. chl.	1.139	82	222	v. s.	v. s.	sl. s.
8	.....	.....	166–7 d.	.....	.....	s.	s. a.
9	leaf.	.....	235 d.	.....	.....	s.	.....
10	need.	.....	187	.....	i.	s.	.....
11	leaf.	.....	201	.....	s. h.	s.	.....
12	need.	.....	148–9	.....	v. s.	s.	v. sl. s.
13	monocl.	$1.293^{21°}$	166	.....	.....	.....	.....
14	white leaf.	$1.211^{4°}$	114.2	303.8	0.5	40	8.3
15	whte.cryst	.....	78–84	303–5	v. s. h.	$55.2^{1°}$	.....
16	pl.	.....	70–80 (108)	.....	d. 100°	.....	v. s.
17	pl.	1.008	42	261	i.	v. s.	s.; s. H_2SO_4
18	liq.	$1.051\frac{25°}{4°}$	16.7	118.1	∞	∞	∞
19	liq.	$1.080^{15°}$	.....	137	dec.	∞	∞
20	colorl. cryst.	.....	159	.....	s. h.	v. s.	.....
21	leaf.	.....	132	.....	s. h.	s.	.....
22	.....	.....	85	.....	sl. s.	s.	s.
23	liq.	$1.045^{18°}$	.....	89 expl.	i.	s.	.....

No.	Name	Synonyms	Formula	Mol. wt.
1	Acetoglyceral....	.....	$C_3H_5(OH)O_2C_2H_4$...	118.08
2	Aceto-acetic ether.	See *ethyl acetoacetate*		
3	Acetohydroxy-benzoic acid	.....	$C_2H_3O\cdot OC_6H_4\cdot COOH$	180.06
4	Acetol.....	acetyl carbinol...	$CH_3\cdot CO\cdot CH_2OH$...	74.05
5	Acetone.....	dimethyl ketone..	$CH_3\cdot CO\cdot CH_3$.....	58.05
6	Acetone acid....	hydroxyiso-butyric acid	$(CH_3)_2\cdot C\cdot (OH)\cdot COOH$	104.06
7	Acetonechloride..	.....	$CH_3\cdot CCl_2\cdot CH_3$.....	112.96
8	Acetonecyan-hydrine	.....	$(CH_3)_2C(OH)\cdot CN$..	85.06
9	Acetonediacetic acid	.....	$CO(C_2H_4\cdot COOH)_2$..	174.08
10	Acetonedicar-boxylic acid	.....	$CO(CH_2\cdot COOH)_2$...	146.05
11	Acetone phenyl-hydrazone	.....	$(CH_3)_2C:N_2H\cdot C_6H_5$	148.11
12	Acetonitrile.	See *methyl cyanide*		
13	Acetonylurea....	.....	$C_5H_8N_2O_3$.....	144.08
14	Acetophenine....	.....	$C_{22}H_{17}N$.....	307.14
15	Acetophenone....	phenyl methyl ketone, hypnone	$CH_3\cdot CO\cdot C_6H_5$.....	120.06
16	Acetophenone-acetone	.....	$C_6H_5\cdot CO\cdot C_2H_4\cdot CO\cdot CH_3$	176.10
17	Acetophenone-alcohol	hydroxy-aceto-phenone	$C_6H_5CO\cdot CH_2OH$...	136.06
18	Acetopropionic acid (β)	.....	$CH_3\cdot CO\cdot C_2H_4\cdot COOH$	116.06
19	Acetothioamide...	.....	$CH_3\cdot CS\cdot NH_2$.....	75.11
20	Acetoxime.....	.....	$(CH_3)_2C:NOH$.....	73.06
21	Acetphenetidide (p.)	phenacetin, oxy-ethyl acetanilide	$CH_3CO\cdot NH\cdot C_6H_4\cdot OC_2H_5$	179.11
22	Acet-toluide (o.)	.....	$CH_3\cdot C_6H_4\cdot NH\cdot COCH_3$	149.10
23	" (m.)	.....	$CH_3\cdot C_6H_4\cdot NH\cdot COCH_3$	149.10
24	" (p.)	.....	$CH_3\cdot C_6H_4\cdot NH\cdot COCH_3$	149.10
25	Aceturic acid....	.....	$(C_2H_3O)NH\cdot CH_2\cdot COOH$	117.06
26	Acetyl-acetone...	.....	$CH_3CO\cdot CH_2COCH_3$	100.06
27	Acetylamino-benzoic acid (o.)	.....	$CH_3CO\cdot NH\cdot C_6H_4\cdot COOH$	179.08
28	Acetylamino-benzoic acid (m.)	.....	$CH_3CO\cdot NH\cdot C_6H_4\cdot COOH$	179.08
29	Acetylamino-benzoic acid (p.)	.....	$CH_3CO\cdot NH\cdot C_6H_4\cdot COOH$	179.08
30	Acetylbenzoic acid (o.)	.....	$CH_3\cdot CO\cdot C_6H_4\cdot COOH$	164.06
31	Acetylbenzoic acid (p.)	.....	$CH_3\cdot CO\cdot C_6H_4\cdot COOH$	164.06
32	Acetyl-biuret....	.....	$CH_3\cdot CO\cdot NH\cdot CO\cdot NH\cdot CO\cdot NH_2$	145.08
33	bromide.....	.....	$CH_3\cdot CO\cdot Br$.....	122.94

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form and color	Sp. gr. H_2O = 1 (A)Air = 1	Melting-point °C	Boiling-point °C	Solubility in gms. per 100 c.c. of		
					Water	Alcohol	Ether
1	liq.	$1.081^{0°}$	.....	184–8	sl. s.	s.	.....
2							
3	cryst.	.....	127	.....	s. h.	s.	s.
4	liq.	.....	.....	145–50	∞	∞	∞
5	liq.	$0.792^{20°}$	−94.6	56.5	∞	∞	∞
6	pr.	.....	79; subl. 50	212	v. s.	v. s.	v. s.
7	liq.	$1.827^{16°}$	.....	69.7	.....	.....	.....
8	liq.	.....	.....	120	.....	.....	.....
9	leaf.	.....	143	.....	.....	s.	sl. s.
10	.....	.....	135	dec.	v. s.	s.	v. sl. s.; i. bz.; i. chl.
11	.....	.....	16 $1H_2O$; 42 anh.	165	s.	s.	s.; s. dil. min. a.
12							
13	pr.	$0.8018^{4°}$	−41	82	s.	s.	s.
14	need.	.....	135	.....	.....	s.	.....
15	pl.	$1.033\frac{18°}{4°}$	20.5	202	i.	s.	s.
16	.....	.....	.....	dec.	sl. s. c.	.....	.....
17	hex. pl.	.....	86	.....	v. s. h.	s.	s.
18	leaf.	$1.1367^{25°}$	.....	250–3	.....	.....	.....
19	monocl. pr.	.....	108	.....	v. s.	s.	.....
20	prisms	$0.8877\frac{5°}{4°}$	59–60	135	v. s.	v. s.	v. s.
21	leaf.	.....	134–5	.....	0.11	6	1.3
22	colorl. cryst.	$1.168^{15°}$	107–110	296	0.86	s.	s.
23	cryst.	.....	65.5	303	$0.44^{13°}$	.....	.....
24	need.	.....	151–3	307	0.09	10.8	.....
25	need.	.....	206	.....	$2.7^{15°}$	v. s.	i.
26	liq.	$0.987^{15°}$	.....	139.6	12.5	∞	∞
27	need.	.....	185	.....	sl.s.; s.h.	s. h.	s.
28	.....	.....	248 d.	.....	sl. s. h.	sl. s. h.	sl. s.
29	need.	.....	250 d.	.....	sl. s.	s.	sl. s.
30	cryst.	.....	114	.....	s. h.	.....	.....
31	need.	.....	200	subl.	sl. s.	sl. s.	sl. s.
32	need.	.....	193	.....	v. s.	.....	v. sl. s.
33	liq.	.....	.....	81	d.	d.	s.

No.	Name	Synonyms	Formula	Mol. wt.
1	Acetyl-carbazole (9)		$C_{12}H_8N \cdot C_2H_3O$	209.10
2	chloride		$CH_3 \cdot CO \cdot Cl$	78.48
3	cyanide		$CH_3 \cdot CO \cdot CN$	69.03
4	diphenylamine		$(C_6H_5)_2N \cdot C_2H_3O$	211.11
5	disulfide		$(CH_3 \cdot CO)_2S_2$	150.18
6	ethylmalonate		$(CH_3 \cdot CO) \cdot CH(CO_2 \cdot C_2H_5)_2$	202.11
7	ethyloxamate		$NH(C_2H_3O) \cdot C_2O_2 \cdot OC_2H_5$	159.08
8	ethylsuccinate		$CH_3 \cdot CO \cdot CH(CH_2 \cdot CO_2C_2H_5)(CO_2C_2H_5)$	216.13
9	glycine		$CH_2(NH \cdot C_2H_3O) \cdot CO_2H$	117.06
10	indol (1)		$C_8H_6(C_2H_3O)N$	159.08
11	iodide		C_2H_3OI	169.96
12	isatin		$C_6H_4 \cdot CO_2 \cdot N(C_2H_3O)$	177.06
13	malic acid		$C_2H_3(O \cdot C_2H_3O)(COOH)_2$	176.06
14	naphthol		$C_{10}H_7O \cdot C_2H_3O$	186.08
15	peroxide		$(CH_3CO)_2O_2$	118.05
16	phenol		$C_6H_5O \cdot C_2H_3O$	136.06
17	phenylene-diamine (p.)	amino-acetanilide	$NH_2 \cdot C_6H_4 \cdot NH \cdot COCH_3$	150.10
18	phenylhydrazine (α)	hydracetin	$C_6H_5 \cdot NH \cdot NH \cdot COCH_3$	150.10
19	pyrrol (1)		$C_4H_4N \cdot C_2H_3O$	109.06
20	salicylic acid	aspirin	$C_6H_4 < \begin{matrix} O \cdot COCH_3 \\ COOH \end{matrix}$	180.06
21	thiourea		$CS \cdot NH(C_2H_3O)NH_2$	118.13
22	urea		$NH_2 \cdot CO \cdot NH \cdot COCH_3$	102.06
23	Acetylene		$HC \vdots CH$	26.02
24	dicarboxylic acid		$C_2(COOH)_2$	114.02
25	dichloride		$CHCl \vdots CHCl$	96.91
26	tetrabromide		$CHBr_2 \cdot CHBr_2$	345.68
27	tetrachloride	tetrachlorethane	$CHCl_2 \cdot CHCl_2$	167.84
28	urea		$C_2H_2(CO \cdot N_2H_2)_2$	142.08
29	Achroodextrin		$C_{36}H_{62}O_{31}$?	990.50
30	Aconic acid		$CH_2 \cdot CO \cdot O \cdot CH : C \cdot COOH$	128.03
31	Aconine		$C_{25}H_{41}NO_9$	499.34
32	Aconitic acid	equisetic acid	$C_3H_3(COOH)_3$	174.05
33	Aconitine	acetylbenzoyl-aconine	$C_{34}H_{47}O_{11}N$(?)	645.38
34	hydrobromide		$C_{34}H_{47}O_{11}N \cdot HBr + 2\frac{1}{2}H_2O$	771.35
35	Acridine		$C_6H_4 < \begin{matrix} CH \\ N \end{matrix} > C_6H_4$	179.08
36	Acrolein	acrylic aldehyde	$CH_2 : CH \cdot CHO$	56.03

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form and color	Sp. gr. $H_2O = 1$ (A)Air = 1	Melting-point °C	Boiling-point °C	Solubility in gms. per 100 c.c. of		
					Water	Alcohol	Ether
1	need. f. w.	.....	69	>360 d.	sl. s.	s.	s.
2	liq.	$1.105^{20°}$	.....	55 (50.9)	d.	d.	s.
3	.....	.....	.....	93	.....	.....	.....
4	lng. need.	.....	99.5	.....	.....	.....	s.
5	cryst.	.....	20°	d.	i.	s.	s. CS_2
6	liq.	$1.080^{23°}$	.....	240	s. N_2CO_3	.....	.....
7	need.	.....	54	.....	i.	s.	s.
8	liq.	$1.079^{21°}_{18}$	.....	254–6 133–4 $^{8mm.}$	i.	s	.....
9	cryst.	.....	d. 130	.....	s.	s.	.....
10	liq.	.....	.....	152–3 $^{14mm.}$	....	....	....
11	br. liq.	$1.98^{17°}$	.....	108	d.	.....	.....
12	yel. pr.	.....	141	.....	sl. s.	s.	s. bz.
13	cryst.	.....	132	d.	.....	.....	.....
14	.....	$1.1336^{0°}$	.....	296	.....	s.	s.
15	leaf.	.....	30	$63^{21mm.}$	sl. s.	.....	∞
16	liq. yel.	1.074	.....	193	.....	.....	.....
17	need.	.....	159.5	.....	sl. s.	v. s.	v. s.
18	colorl. cryst.	.....	128–30	.....	sl. s.; s. h.	s.	sl. s.
19	liq.	.....	.....	181–2	v. sl. s.	.....	.....
20	colorl. cryst.	.....	135	.....	sl. s.	s.	s.
21	prisms	.....	165	.....	s. h.	s.	sl. s.
22	.....	.....	218–9	.....	v. s. h.	$1^{30°}$	.....
23	gas	0.906(A)	–81	–85	v. sl. s.	s.	25 in 1
24	long pr.	.....	175	.....	v. s.	v. s.	v. s.
25	liq.	.....	.....	55	.....	.....	.....
26	yel. liq.	2.97	.....	136–7 $^{36mm.}$ d.239–42	i.	s.	∞
27	liq.	$1.58^{25°}$	.....	147	i.	∞	∞
28	need.f.w.	.....	.....	.....	$1.333^{15°}$	s.	a.
29	amor. wh.	.....	.....	.....	s.	i.	colorl. w. I
30	rh'b'd. f. w.	.....	164	.....	$18^{15°}$	.....	.....
31	.....	.....	175	.....	v. s.	v. s.	i.
32	leaf.	.....	191 d.	.....	18	$50^{12°}$	sl. s.
33	prisms	.....	abt. 190	.....	.03	4.5	2.25
34	hex. tab.	.....	160–3	.....	s.	s.	.....
35	leaf.	.....	107	abt. 360	v. sl. s	v. s.	v. s.
36	liq.	0.84	.....	52.4	40	s.	s.

PHYSICAL CONSTANTS OF

No.	Name	Synonyms	Formula	Mol. wt.
1	Acrylic acid.....	ethylenecarboxylic acid	$CH_2:CH\cdot COOH$...	72.03
2	Adenine.....	.....	$C_5H_5N_5$.....	135.08
3	Adipic acid.....	.....	$COOH(CH_2)_4COOH$	146.08
4	Aesculin.....	esculin.....	$C_{15}H_{16}O_9$.....	340.13
5	Aesculetin.....	.....	$C_9H_6O_4 + H_2O$.....	196.06
6	Aldehyde.	See *acetaldehyde*		
7	ammonia.....	.....	$CH_3\cdot CH(OH)NH_2$	61.06
8	benzoic acid (o.)	.....	$COOH\cdot C_6H_4\cdot CHO$	150.05
9	" " (m.)	.....	$COOH\cdot C_6H_4\cdot CHO$	150.05
10	" " (p.)	.....	$COOH\cdot C_6H_4\cdot CHO$	150.05
11	Aldehydin.....	.....	$(CH_3)(C_2H_5)C_5H_2N$	120.09
12	Aldehydohydroxybenzoic acid (3, 1, 4)	.....	$C_6H_3(OH)(COOH)(CHO\cdot)$	166.05
13	Aldehydohydroxybenzoic acid (4, 1, 3)	.....	$C_6H_3(OH)(COOH)(CHO)$	166.05
14	Aldehydohydroxybenzoic acid (3, 1, 2)	.....	$C_6H_3(OH)(COOH)(CHO)$	166.05
15	Aldehydohydroxybenzoic acid (2, 1, 5)	.....	$C_6H_3(OH)(COOH)(CHO)$	166.05
16	Alizarine.....	dihydroxyanthraquinone (α, β)	$C_6H_4(CO)_2C_6H_2(OH)_2$	240.06
17	amide (o.).....	.....	$C_6H_4(CO)_2C_6H_2(OH)(NH_2)$	239.08
18	carboxylic acid..	.....	$(COOH)C_6H_3(CO)_2C_6H_2(OH)_2$	284.06
19	Alkanin.....	.....	$C_{15}H_{14}O_4$.....	258.11
20	Allantoin.....	.....	$C_4H_6N_4O_3$.....	158.08
21	Allanturic acid...	.....	$NH_2\cdot CO\cdot NHCO\cdot CHO$	116.05
22	Allocinnamic acid	.....	$C_9H_8O_2$.....	148.06
23	Alloxan.....	mesoxalylurea....	$C_4H_2N_2O_4 + 1$ or $4\ H_2O$	160.05 or 214.10
24	Alloxanic acid...	.....	$NH_2\cdot CO\cdot NH\cdot C_3O_3(OH)$	160.05
25	Alloxantine.....	.....	$C_8H_4O_7N_4$.....	268.06
26	Allyl-acetate.....	.....	$CH_3\cdot COO\cdot C_3H_5$....	100.06
27	acetic acid.....	.....	$C_3H_5\cdot CH_2\cdot COOH$..	100.06
28	acetone.....	.....	$CH_3\cdot CO\cdot CH_2\cdot C_3H_5$	98.08
29	acetonitrile.....	.....	$C_3H_5\cdot CH_2CN$.....	81.06
30	alcohol.....	.....	$CH_2:CH\cdot CH_2OH$..	58.05
31	amine.....	.....	$CH_2:CH\cdot CH_2\cdot NH_2$	57.06
32	aniline.....	.....	$C_6H_5\cdot NH\cdot C_3H_5$....	133.06
33	benzene.....	.....	$C_6H_5\cdot CH:CH\cdot CH_3$	118.08

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form and color	Sp. gr. H_2O = 1 (A)Air = 1	Melting-point °C	Boiling-point °C	Solubility in gms. per 100 c.c. of		
					Water	Alcohol	Ether
1	liq.	$1.062^{16°}$	7–8	140	∞	.....	.....
2	need. f. c. H_2O	.....	360 d.	.....	.09 cold	sl. s.	i.
3	need.	.....	153	$265^{100mm.}$	$1.5^{15°}$	v. s.	sl. s.
4	wh. need.	.....	160	.....	0.16 c., 8 h.	sl. s.	sl. s.
5	need.	.....	270 d.	.....	sl. s. c.	s.	v. sl. s. s. alk.
6							
7	rhomb.	.....	70–80	100	v. s.	v. s.	sl. s.
8	leaf.	1.404	97.2	.....	v. s.	v. s.	v. s.
7	need.	.....	164–6	.....	.....	.....	.....
10	wh. need.	.....	246,(285)	.....	s. h.	v. s.	sl. s.
11	.....	$.9184^{23°}$	.....	173–4	i.	s.	s.
12	need.	.....	234	.....	sl. s.h.	s.	s.
13	pr.	.....	243–4	subl.	s. h.	s.	s.
14	need.	.....	179	.....	$1.15^{100°}$	s.	.....
15	need.	.....	248–9	.....	$1.150^{100°}$	s.	s.
16	or. need.	.....	289–90	430	i. c.	v. s.	v. s.
17	br. need.	.....	150	subl.	i.	s.	s.
18	r. need.	.....	305	subl.	v. sl. s.	s.	sl. s.
19	r. amor.	.....	d. <100	.....	i.	sl. s.	s. glac. acet. a.; s. alk.
20	wh. cryst.	.....	227–31d.	.....	0.6 c.; v. s. h.	v. sl. s.	i.
21	gum.	.....	.....	.....	deliq.	i.	.....
22	monocl.	.....	68	.....	.....	.....	.....
23	pr.	.....	d. abt. 170	.....	v. s.	s.	.....
24	cryst.	.....	d.	.....	v. s.	1 : 5	sl. s.
25	.....	.....	.....	.....	sl. s.	v. sl. s.	v. sl. s.
26	liq.	$0.938^{0°}$	.....	103–4 $^{734mm.}$	sl. s.	∞	∞
27	liq.	$0.984^{18°}$	.....	186–8	sl. s.	v. s.	v. s.
28	liq.	$0.834_{7}^{27.5°}$	.....	128–30	i.	.....	.....
29	liq.	$1.18^{13°}$	.....	140	i.	.....	.....
30	liq.	$0.854^{20°}$	.....	96.6	∞	∞	∞
31	liq.	0.769	.....	56.0–56.5	v. s.	s.	∞
32	yel. oil	$0.982^{25°}$	.....	208–9	sl. s.	s.	.....
33	liq.	0.914	.....	176–7	.....	s.	.....

No.	Name	Synonyms	Formula	Mol. wt.
	Allyl-			
1	benzoate		$C_6H_5 \cdot CO_2 \cdot C_3H_5$	162.08
2	bromide	monobromopropylene (γ)	$CH_2 : CH \cdot CH_2Br$	120.96
3	chloride	monochloropropylene (γ)	$CH_2 : CH \cdot CH_2Cl$	76.50
4	cinnamate		$C_6H_5CH : CH \cdot COO \cdot C_3H_5$	188.10
5	cyanide		$CH_2 : CH \cdot CH_2CN$	67.05
6	ether		$(CH_2 : CH \cdot CH_2)_2O$	98.08
7	formate		$HCOO \cdot C_3H_5$	86.05
8	iodide		$CH_2 : CH \cdot CH_2I$	167.97
9	isoamyl ether		$C_3H_5 \cdot O \cdot C_5H_{11}$	128.13
10	isocyanide		$CH_2 : CHCH_2NC$	67.05
11	malonic acid		$CH(C_3H_5)(COOH)_2$	144.06
12	mercaptan		$CH_2 : CH \cdot CH_2SH$	74.11
13	mustard oil	allyl isosulfocyanicester, allyl isothiocyanate	$CH_2 : CH \cdot CH_2NCS$	99.11
14	oxalate		$C_2O_4(C_3H_5)_2$	170.08
15	phenyl ether		$C_6H_5 \cdot OC_3H_5$	134.08
16	phenylurea		$NH(C_3H_5)CONH(C_6H_5)$	176.11
17	pyridine (1)		$C_3H_5 \cdot C_5H_4 \cdot N$	119.08
18	sulfide	thioallyl ether	$(CH_2 : CH \cdot CH_2)_2S$	114.14
19	sulfocarbamide	thiosinamine	$C_3H_5 \cdot NH \cdot CS \cdot NH_2$	116.11
20	thiocyanate		$C_3H_5 \cdot SCN$	99.11
21	trisulfide		$(C_3H_5)_2S_3$	178.27
22	Allylene	methyl acetylene, propine	$CH_3 \cdot C : CH$	40.03
23	dichloride		$C_3H_4Cl_2$	110.95
24	oxide		$CH_3 \cdot (C : CH)O$	56.03
25	Aloïn		$C_{17}H_{18}O_7 + \frac{1}{2}H_2O$	343.15
26	Alstonine		$C_{21}H_{20}N_2O_4 + 3\frac{1}{2}\ H_2O$	427.22
27	Aluminum-ethyl		$Al(C_2H_5)_3$	114.09
28	methyl		$Al(CH_3)_3$	72.04
29	Amalinic acid	tetramethyl alloxantin	$C_8(CH_3)_4N_4O_7$	324.13
30				
31	Amarin	triphenyl dihydroglyoxalin	$(C_6H_5)CH \cdot (C_6H_5) \cdot CH$ $NH(C_6H_5)C : N$	298.16
32	Amidol	See *diaminophenol*	*hydrochloride*	
33	Amino-acetanilid (p.)		$NH_2 \cdot C_6H_4 \cdot NH \cdot COCH_3$	150.10
34	acetic acid	glycin, glycocoll	$NH_2 \cdot CH_2 \cdot COOH$	75.05
35	acetophenone (p.)		$NH_2 \cdot C_6H_4COCH_3$	135.08
36	anthraquinone (1)		$NH_2 \cdot C_6H_3 : (CO)_2 : C_6H_4$	223.08
37	" (2)		$NH_2 \cdot C_6H_3 : (CO)_2 : C_6H_4$	223.08
38	azo-benzene (p.)	aniline yellow	$NH_2 \cdot C_6H_4 \cdot N_2 \cdot C_6H_5$	197.11
39	azo-naphthalene (4, α, α)		$C_{10}H_7 \cdot N_2 \cdot C_{10}H_6 \cdot NH_2$	297.14
40	azophenylene	azimido benzene	$C_6H_4 \cdot NH \cdot N : N$	119.06

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form and color	Sp. gr. $H_2O = 1$ (A) Air = 1	Melting-point °C	Boiling point °C	Solubility in gms. per 100 c.c. of		
					Water	Alcohol	Ether
1	.....	1.059	.....	228	.....	.....	.....
2	liq.	1.436	.....	70–71	i.	∞	∞
3	liq.	$0.937^{20°}$	.....	44.6–46	i.	s.	∞
4	wh. cryst.	$1.052^{25°}_{25°}$	.....	284–6 d.	i.	v. s.	∞
5	.....	0.835	.....	119	.....	s.	.....
6	.....	$0.805^{18°}$	.....	94.3	sl. s.	∞	∞
7	liq.	0.932	.....	82–3	.....	s.	.....
8	yel. liq.	$1.89^{18°}$	.....	101–2	i.	s.	.....
9	liq.	.....	.....	120	v. sl. s.	∞	∞
10	liq.	$0.794^{17°}$	.....	96–106	sl. s.	s.	∞
11	pr.	.....	103	d.	s.	s.	s.; s. bz.
12	.....	.....	.....	90	.....	∞	∞
13	liq.	$1.017^{10°}$	.....	150.7	v. sl. s.	v. s.	v. s.
14	.....	1.055	.....	217	i.	s.	.....
15	.....	0.986	.....	191.7	i.	.....	.....
16	need.	.....	96–7	.....	.....	.....	.....
17	liq.	$0.959^{0°}$	.....	189–90	.....	.....	.....
18	.....	$0.888^{27°}$	.....	140	sl. s.	∞	∞
19	.....	.....	74	.....	v. s.	v. s.	v. s.
20	.....	1.056	.....	161	i.	.....	.....
21	liq.	.....	.....	140	s.	.....	.....
22	gas	.....	−110	−23.5	.....	.....	3000 c.c.
23	liq.	.....	.....	75 (84–6)	.....	.....	.....
24	.....	.....	.....	62–3	sl. s.	.....	.....
25	yel. need.	.....	d. 100	.....	sl. s. c.	sl. s. c.	s. KOH
26	br. amor.	.....	<100; 195 anh.	.....	.....	s.	v. sl. s.; s. chl.
27	liq.	.....	.....	194	d.	.....	.....
28	liq.	.....	0	130	.....	.....	.....
29	cryst.	.....	.....	.....	sl. s. h.	v. sl. s.	s. KOH
30							
31	.....	.....	100; anh. 130	.....	i.	s.	s.
32							
33	need.	.....	159.5	.....	sl. s.	v. s.	v. s.
34	monocl.	1.161	233 d.	.....	23	i.	i.
35	yel. pr.	.....	105–6	.....	v. sl. s.	s.	s.
36	red need.	.....	242	.....	i.	s.	s.
37	red need.	.....	302	subl.	i.	s.	s.; s. 62
38	yel. need.	.....	125–6	abt. 360	sl. s. h.	s. h.	s.
39	red need.	.....	173–5	.....	.....	sl. s.	sl. s.
40	need.	.....	98.5	.....	.....	s.	s. bz.

No.	Name	Synonyms	Formula	Mol. wt.
1	Amino-azotoluene..... $CH_3:N:N:CH_3:NH_2$ (1 2 5 1 2)	.....	$C_6H_4\cdot CH_3\cdot N_2\cdot C_6H_4\cdot CH_3\cdot NH_2$	226.15
2	1 3 5 1 2	.....	$C_6H_4\cdot CH_3\cdot N_2\cdot C_6H_4\cdot CH_3\cdot NH_2$	226.15
3	1 4 5 1 2	.....	$C_6H_4\cdot CH_3\cdot N_2\cdot C_6H_4\cdot CH_3NH_2$	226.15
4	1 4 6 1 3	.....	$C_6H_4\cdot CH_3\cdot N_2\cdot C_6H_4\cdot CH_3NH_2$	226.15
5	benzaldehyde (o.)	.....	$NH_2\cdot C_6H_4\cdot CHO$...	121.06
6	" (m.)	.....	$NH_2\cdot C_6H_4\cdot CHO$...	121.06
7	" (p.)	.....	$NH_2\cdot C_6H_4\cdot CHO$...	121.06
8	benzamide (o.)..	.....	$NH_2\cdot C_6H_4\cdot CONH_2$..	136.08
9	" (m.).	.....	$NH_2\cdot C_6H_4\cdot CONH_2$..	136.08
10	" (p.)..	.....	$NH_2\cdot C_6H_4\cdot CONH_2$..	136.08
11	benzene.	See *aniline*		
12	benzene-sulfonic acid (o.)	.....	$NH_2\cdot C_6H_4\cdot SO_3H + \frac{1}{2}H_2O$	182.14
13	benzene-sulfonic acid (m.)	metanilic acid....	$NH_2\cdot C_6H_4\cdot SO_3H + 1\frac{1}{2}H_2O$	200.15
14	benzene-sulfonic acid (p.)	See *sulphanilic acid*		
15	benzidine (2)...	.....	$(NH_2)_2C_6H_3\cdot C_6H_4 NH_2$	199.13
16	benzoic acid (o.)	anthranilic acid...	$NH_2\cdot C_6H_4\cdot COOH$	137.06
17	" " (m.)	.....	$NH_2\cdot C_6H_4\cdot COOH$..	137.06
18	" " (p.)	.....	$NH_2\cdot C_6H_4\cdot COOH$..	137.06
19	benzophenone (o.)	.....	$C_6H_5\cdot CO\cdot C_6H_4NH_2$	197.10
20	" (m.)	.....	$C_6H_5\cdot CO\cdot C_6H_4NH_2$	197.10
21	" (p.)	.....	$C_6H_5\cdot CO\cdot C_6H_4NH_2$	197.10
22	benzonitrile (m.)	.....	$NH_2\cdot C_6H_4\cdot CN$.....	118.06
23	" (p.)	.....	$NH_2\cdot C_6H_4\cdot CN$.....	118.06
24	butyric acid (α)	.....	$C_2H_5\cdot CH(NH_2)\cdot COOH$	103.08
25	" " (β)	.....	$CH_3CH(NH_2)\cdot CH_2\cdot COOH$	103.08
26	camphor.....	.....	$C_{10}H_{15}(NH_2)O$.....	167.14
27	cinnamic acid (o.)	.....	$NH_2\cdot C_6H_4\cdot CH:CH\cdot COOH$	163.08
28	" " (m.)	.....	$NH_2\cdot C_6H_4\cdot CH:CH\cdot COOH$	163.08
29	" " (p.)	.....	$NH_2\cdot C_6H_4\cdot CH:CH\cdot COOH$	163.08
30	4 cresol (2).....	.....	$NH_2\cdot C_6H_3\cdot CH_3(OH)$	123.08
31	5 " (2).....	.....	$NH_2\cdot C_6H_3\cdot CH_3(OH)$	123.08
32	6 " (2).....	.....	$NH_2\cdot C_6H_3\cdot CH_3(OH)$	123.08
33	6 " (3).....	.....	$NH_2\cdot C_6H_3\cdot CH_3(OH)$	123.08
34	2 " (4).....	.....	$NH_2\cdot C_6H_3\cdot CH_3(OH)$	123.08
35	3 " (4).....	.....	$NH_2\cdot C_6H_3\cdot CH_3(OH)$	123.08
36	dimethyl aniline (o.)	.....	$NH_2\cdot C_6H_4\cdot N(CH_3)_2$	136.11
37	" " (m.)	.....	$NH_2\cdot C_6H_4\cdot N(CH_3)_2$	136.11
38	" " (p.)	.....	$NH_2\cdot C_6H_4\cdot N(CH_3)_2$	136.11
39	diphenyl (o.)...	.....	$NH_2\cdot C_6H_4\cdot C_6H_5$....	169.10
40	" (m.)...	.....	$NH_2\cdot C_6H_4\cdot C_6H_5$....	169.10
41	" (p.)...	xenylamine.....	$NH_2\cdot C_6H_4\cdot C_6H_5$....	169.10

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form and color	Sp. gr. H_2O = 1 (A)Air = 1	Melting-point °C	Boiling-point °C	Solubility in gms. per 100 c.c. of		
					Water	Alcohol	Ether
1	yel. pl.	.....	100	.....	.....	s.	.....
2	yel. need.	.....	80	.....	sl. s.	s.	.....
3	yel. pl.	.....	127–8	.....	i.	sl. s.	.....
4	yel. lvs.	.....	127	.....	i.	s.	.....
5	leaf.	.....	39	decomp.	sl. s.	v. s.	v. s.
6	yel. amor.	.....	.....	.....	.....	.....	.....
7	flat plates	.....	70	.....	s.	.....	.....
8	leaf.	.....	108	.....	s. h.	v. s.	sl. s
9	yellow	.....	79	abt. 300	sl. s.	s.	s.
10	yellow	.....	178–9	.....	sl. s.	.....	.....
11			(182.9)				
12	prisms	.....	.....	.....	$1.5^{15°}$	sl. s.	sl. s.
13	need. or pr.	.....	.....	.....	s.	sl. s.	sl. s.
14							
15	need.	.....	134	.....	.....	.....	.....
16	yel. lf.	.....	144–5	.....	$0.35^{113.8°}$	$10.7^{9.6°}$	$16.05^{8.8}$
17	yel. cryst.	.....	174	.....	$0.56^{10°}$	$2.2^{10°}$	$1.7^{10°}$
18	yel. cryst.	.....	186–7	.....	$0.33^{10°}$	$11.3^{10°}$	$6.11^{10°}$
19	yel. leaf.	.....	106	.....	.....	s.	s.
20	need.	.....	87	.....	i.	s.	s.
21	leaf.	.....	124	.....	sl. s.	s.	s.
22	need.	.....	53–4	288–90	sl. s.	v. sl. s.	v. sl. s
23	colorl.	.....	86	.....	v. s. h.	v. s.	v. s.
24	leaf.	.....	d.	.....	1 : 3.5	1 : 550 h.	.....
25	need.	.....	184	.....	deliq.	i. abs.	i.
26	waxy	.....	226–8	246.4	.....	.....	s. a.
27	need.	.....	158–9 d.	.....	sl. s. c.; s. h.	s. h.	s.
28	yel. need.	.....	180–1	.....	sl. s. c.; v. s. h.	v. s.	v. s.
29	yel. need.	.....	175–6 d.	.....	sl. s. c.; v. s. h.	v. s.	v. s.
30	colorl. leaf. or need.	.....	159–61	.....	s. c.; v. s. h.	v. s.	v. s.
31	leaf. f. bz.	.....	abt. 174	.....	s.	v. s.	v. s.
32	need.	.....	124–8	.....	sl. s.	.....	sl. s.
33	warts f.bz.	.....	174 d.	.....	.....	.....	.....
34	colorl.	.....	144.5	.....	.....	.....	.....
35	sc. f. eth.	.....	135	.....	v. sl. s.	v. s.	v. s.
36	.....	.....	.....	218	.....	.....	.....
37	.....	.....	.....	268–70	.....	.....	.....
38	.....	.....	41	262	.....	.....	.....
39	colorl.leaf.	.....	45.5	299	i.	s.	.....
40	.....	.....	30	254	.....	.....	.....
41	colorl.leaf.	.....	53	302	sl. s. h.	v. s.	v. s.

No.	Name	Synonyms	Formula	Mol. wt.
1	Amino-diphenylamine (o.)	.....	$NH_2 \cdot C_6H_4 \cdot NH \cdot C_6H_5$	184.11
2	ethanol.....	ethanol amine ...	$NH_2 \cdot CH_2 \cdot CH_2 \cdot OH$	61.06
3	ethyl benzene (o.)	.....	$NH_2 \cdot C_6H_4 \cdot C_2H_5$....	121.10
4	" " (m.)	.....	$NH_2 \cdot C_6H_4 \cdot C_2H_5$....	121.10
5	" " (p.)	.....	$NH_2 \cdot C_6H_4 \cdot C_2H_5$....	121.10
6	guanidine.....	.....	$(NH)C<^{NHNH_2}_{NH_2}$	74.08
7	hexahydro-benzene	.....	$C_6H_5(NH_2)H_6$.....	99.11
8	isocaproic (α) acid	.....	$(CH_3)_2CH \cdot CH_2 \cdot CH(NH_2)COOH$	131.11
9	isopropylbenzene	.....	$C_6H_4(C_3H_7)NH_2$....	130.07
10	isovaleric acid (α)	.....	$(CH_3)_2CHCH(NH_2)COOH$	117.10
11	" " (β)	.....	$(CH_3)_2C(NH_2)CH_2 \cdot COOH$	117.10
12	malonic acid...	.....	$NH_2 \cdot CH(COOH)_2$..	119.05
13	naphthol (7, 2)..	.....	$C_{10}H_6(NH_2)OH$.....	159.08
14	" (1, 2)..	.....	$C_{10}H_6(NH_2)OH$.....	159.08
15	" (4, 1)..	.....	$C_{10}H_6(NH_2)OH$.....	159.08
16	phenol (o.).....	.....	$NH_2 \cdot C_6H_4 \cdot OH$.....	109.06
17	" (m.).....	.....	$NH_2 \cdot C_6H_4 \cdot OH$.....	109.06
18	" (p.).....	para-amidophenol, rodinol	$NH_2 \cdot C_6H_4 \cdot OH$.....	109.06
19	propionic acid (α, d.)	d-alanine.....	$CH_3 \cdot CH(NH_2)COOH$	89.06
20	propionic acid (α, *l.*)	l-alanine.....	$CH_3 \cdot CH(NH_2)COOH$	89.06
21	propionic acid (α, rac.)	d, l-alanine.....	$CH_3 \cdot CH(NH_2)COOH$	89.06
22	propionic acid (β)	β-alanine.....	$CH_2(NH_2)CH_2COOH$	89.06
23	pyridine (2)....	.....	$NH_2 \cdot C_5H_4N$.....	94.06
24	" (3)....	.....	$NH_2 \cdot C_5H_4N$.....	94.06
25	" (4)....	.....	$NH_2 \cdot C_5H_4N$.....	94.06
26	quinoline (2)....	.....	$C_9H_6N \cdot NH_2$.....	144.08
27	" (4)....	.....	$C_9H_6N \cdot NH_2$.....	144.08
28	salicylic acid (3)	.....	$NH_2 \cdot C_6H_3(OH)(COOH)$	153.06
29	" " (5)	.....	$NH_2 \cdot C_6H_3(OH)(COOH)$	153.06
30	thiazol.....	.....	$C_3H_2NS \cdot NH_2$.....	100.11
31	thiophene.....	.....	$NH_2C_4H_3S$.....	99.11
32	thiophenol (o.)..	.....	$C_6H_4(NH_2)SH$.....	125.13
33	triphenyl-methane	.....	$(C_6H_5)_2CH \cdot C_6H_4NH_2$	259.14
34	valeric acid (α)	.....	$CH_3CH_2CH_2CH(NH_2)COOH$	117.10
35	" " (γ)	.....	$CH_3CH(NH_2)CH_2CH_2COOH$	117.10

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form and color	Sp. gr. $H_2O = 1$ (A)Air = 1	Melting-point °C	Boiling-point °C	Solubility in gms. per 100 c.c. of		
					Water	Alcohol	Ether
1	need. f. w.	.....	79–80	.....	s.	.....	s. a.; i. lgr.; s. bz.
2	colorl. liq.	$1.022^{20°}$	.....	171	∞	∞	1
3	liq.	$0.983^{22°}$	.....	215–6	.....	.....	.....
4	colorl. liq.	$0.990^{0°}$	.....	214–15	.....	.....	.....
5	leaf.	$0.975^{22°}$ 5	.....	216–65	.....	.....	.....
6	cryst.	.....	d.	.....	s.	s.	i.
7	colorl. liq.	$0.8678^{20°}_{4°}$	.....	134	.....	.....	.....
8	leaf.	.....	.....	.....	1 : 117.5	sl. s.	.....
9	.....	.....	41	257	s.	s.	s. bz.
10	leaf.	.....	291.5 d.	.....	s.	sl. s.	i.
11	pr.	.....	217	.....	v. s.	i.	i.
12	colorl.	.....	109. d.	.....	sl. s.	sl. s.	.....
13	need.	.....	200 d.	.....	s. HCl.	s.	s.
14	leaf.	.....	.....	.....	s. h.	.....	s. fluor.
15	.....	.....	.....	.....	s. w. d.	w. $FeCl_3$ gives naphtho quinone	
16	rhomb.	.....	170	subl.	1.7°	4.4°	v. s.
17	colorl.	.....	123	.....	2.6	v. s.	v. s.
18	leaf.	.....	184 d.	.....	1.1°	4.5°	sl. s.
19	colorl.	.....	293	.....	20	v. sl. s.	.....
20	prisms	.....	297 d.	.....	.....	.....	.....
21	colorl.	.....	195	.....	v. s.	$0.37^{25°}$	.....
22	prisms f al.	.....	196	.....	v. s.	v. sl. s. abs.	i.
23	leaf. f. lgr.	.....	56	204	.....	v. s.	.....
24	leaf. f. bz.	.....	64	250–2	v. s.	v. s.	v. s.
25	need. f. bz.	.....	154.8	.....	v. s.	v. s.	s.
26	leaf.	.....	129	.....	v. sl. s.; s. h.	v. s.	v. s.
27	need. f. w.	.....	154 (+H_2O 69–70)	.....	s.	s.	v. s. chl.
28	.....	.....	235 d.	.....	.....	v. sl. s.	.....
29	need.	.....	280 d.	.....	i.	i.	.....
30	yel. pl.	.....	90	d.	sl. s.	sl. s.	sl. s.
31	yel. oil	.....	.....	.....	v. s.	v. s.	i.
32	need.	.....	26	d.	.....	.....	.....
33	pr. f. etl.	.....	84	.....	.....	.....	s.; s. bz.. lgr.
34	leaf.	.....	291.5 d.	.....	s.	s.	i.
35	.....	.....	193	d.	v. s.	sl. s.	i.

PHYSICAL CONSTANTS OF

No.	Name	Synonyms	Formula	Mol. wt.
1	Amino-valeric acid (δ)	.....	$NH_2 \cdot CH_2CH_2 \cdot CH_2 \cdot CH_2COOH$	117.10
2	Ammelid.....	.....	$(CN)_3(NH_2)(OH)_2$..	128.06
3	Ammelin.....	.....	$(CN)_3(NH_2)_2OH$....	127.08
4	Amygdalin.....	.....	$C_{20}H_{27}NO_{11} + 3H_2O$	511.27
5	Amygdalinic acid	.....	$(OH)_7 \cdot C_{12}H_{14}O_4 \cdot C_7H_6 \cdot COOH$	476.25
6	Amyl acetate....	amylacetic ester..	$CH_3COO \cdot C_5H_{11}$....	130.11
7	Amyl alcohol (n.)	.....	$CH_3(CH_2)_3CH_2OH$..	88.10
8	" " (act.)	.....	$CH_3(C_2H_5)CH \cdot CH_2OH$	88.10
9	" " (sec. α)	methyl-n-propyl carbinol	$CH_3 \cdot CH_2 \cdot CH_2 \cdot CH(OH) \cdot CH_3$	88.10
10	" " (tert.)	dimethyl ethyl carbinol	$(CH_3)_2 \cdot C(OH) \cdot C_2H_5$	88.10
11	aldehyde.....	.....	$C_5H_9 \cdot CHO$.....	86.08
12	amine.....	.....	$CH_3 \cdot (CH_2)_4NH_2$....	87.11
13	benzene (n.)....	phenyl pentane...	$C_6H_5 \cdot C_5H_{11}$.....	148.13
14	bromide (n.)....	α-bromopentane..	$CH_3 \cdot (CH_2)_4Br$.....	151.00
15	butyrate.....	.....	$C_3H_7 \cdot COOC_5H_{11}$....	158.14
16	carbylamine....	.....	$C_5H_{11}NC$.....	97.10
17	cyanide.....	caproic nitrile....	$C_5H_{11}CN$.....	97.10
18	dimethylbenzene	.....	$C_6H_3(CH_3)_2C_5H_{11}$...	176.16
19	chloride (n.)....	α-chloropentane..	$CH_3(CH_2)_4Cl$.....	106.55
20	ether (n.).....	.....	$(C_5H_{11})_2O$.....	158.18
21	formate (n.)....	.....	$HCOO \cdot C_5H_{11}$.....	116.10
22	glycol (2, 4)....	isoamylene alcohol	$C_5H_{10}(OH)_2$.....	104.10
23	" (1, 4)....	.....	$C_5H_{10}(OH)_2$.....	104.10
24	iodide.....	.....	$CH_3(CH_2)_4I$.....	198.02
25	isobutyrate.....	.....	$C_3H_7COOC_5H_{11}$.....	158.14
26	isothiocyanate..	.....	$C_5H_{11}NCS$.....	129.16
27	mercaptan.....	.....	$C_5H_{11}SH$.....	104.16
28	methylbenzene..	.....	$C_5H_{11}(CH_3)C_6H_4$....	162.14
29	methylether....	.....	$C_5H_{11}OCH_3$.....	102.11
30	nitrate.....	.....	$C_5H_{11}ONO_2$.....	133.10
31	nitrite (n.).....	.....	$C_5H_{11}NO_2$.....	117.10
32	propionate.....	.....	$C_2H_5COOC_5H_{11}$.....	144.13
33	salicylate.....	.....	$HO \cdot C_6H_4 \cdot COOC_5H_{11}$	208.13
34	valeriate.....	apple oil.....	$C_4H_9COOC_5H_{11}$.....	172.16
35	Amylene (n.).....	propyl ethylene...	$CH_3 \cdot (CH_2)_2 \cdot CH : CH_2$	70.08
36	"	ethyl-methyl-ethylene	$C_2H_5CH : CH \cdot CH_3$	70.08
37	"	trimethyl-ethylene	$(CH_3)_2C : CH \cdot CH_3$	70.08
38	Amyloid.....	.....	$(C_6H_{10}O_5)x$	(162.08)x
39	Anaesthesine.....	ethyl para-amino-benzoate	$NH_2 \cdot C_6H_4 \cdot COOC_2H_5$	165.10
40	Anacardic acid...	.....	$C_{22}H_{32}O_3$.....	344.26
41	Analgen.....	o-ethoyx-α-benzoyl-aminoquinoline	$C_7H_5O \cdot NH \cdot C_6H_2(OC_2H_5) : C_3H_3N$	292.14

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form and color	Sp. gr. $H_2O = 1$ (A) Air = 1	Melting-point °C	Boiling-point °C	Solubility in gms. per 100 c.c. of		
					Water	Alcohol	Ether
1	leaf.	.....	158	d.	v. s.	sl. s.	i.
2	wh.	.....	.....	.....	i.	.....	s.
3	mic. need.	.....	d.	.....	$.0214^{23°}$; $.080^{100°}$	i.	i.; s. KOH
4	rhomb. f w.	.....	214–16	.....	$8.3^{10°}$	$0.11^{10°}$	i.
5	cryst.	.....	.....	.....	d.	i.	i
6	liquid	$0.866^{25°}$	.....	148	$0.18^{20°}$	∞	∞
7	colorl. liq.	$0.817^{20°}$	.....	137.8	$2.7^{22°}$	∞	∞
8	colorl. liq.	$0.817^{18°}$	.....	128.7	sl. s.	∞	∞
9	colorl. liq.	$0.824^{0°}$	.....	119	16.7	∞	∞
10	colorl. liq.	0.814	−12	102.5	sl. s.	s.	s.
11	liq.	$0.8185^{11°}$	.....	102	sl. s.	s.	.....
12	colorl. liq.	$0.766^{18°}$	.....	104	s.	s.	∞
13	colorl. liq.	$0.860^{22°}$	.....	201	.....	s.	.....
14	colorl. liq.	$1.223^{20°}$	.....	128.7 (740 mm.)	.....	s.	.....
15	liq.	.....	.....	176	sl. s.	v. s.	v. s.
16	liq.	$<H_2O$	.....	137	i.	s.	.....
17	liq.	$0.866^{20°}$	.....	146	sl. s.	s.	s.
18	liq.	$0.8951^{20°}$	.....	232	.....	s.	.....
19	colorl. liq.	$0.883^{20°}$	.....	106.6 (740 mm.)	.....	s.	.....
20	yel. liq.	$0.775^{25°}$	.....	169	i.	∞	∞
21	colorl. liq.	$0.902^{0°}$	.....	130.4	sl. s.	∞	∞
22	liq.	$0.987^{0°}$	.....	177	∞	∞	∞
23	oil	$1.0003^{0°}$	.....	219–20	s.	s.	i. lgr.
24	.....	$1.517^{20°}$	.....	155.4 (739 mm.)	.....	s.	.....
25	.....	0.859	.....	153–5	sl. s.	.....	.....
26	liq.	$0.9575^{0°}$	.....	183–4	.....	.....	.....
27	liq.	0.8406	.....	120	.....	.....	.....
28	liq.	.....	.....	213	.....	.....	.....
29	liq.	.....	.....	.....	.....	.....	.....
30	liq.	.....	.....	148	.....	.....	.....
31	pa. yel. liq.	.....	.....	96	.....	.....	.....
32	liq.	$<H_2O$	.....	100	.....	.....	.....
33	colorl. liq.	1.052	.....	276–7	.....	33(90%)	.....
34	liq.	.....	.....	196	sl. s.	∞	∞
35	liq.	.....	.....	39–40	i.	∞	∞
36	colorl. liq.	.....	.....	36.5	i.	∞	∞
37	colorl. liq.	0.666	.....	37.1	v. sl. s.	s.	∞
38	.....	.....	.....	.....	s. ammoniacal copper,		
39	rhomb. f. eth.	.....	90–91	.....	v. sl. s.	s.	14.3
40	cryst.	.....	26	.....	i.	v. s.	v. s.
41	yel. cryst.	.....	206	.....	i.	v. sl. s.	s. s.

No.	Name	Synonyms	Formula	Mol. wt.
1	Anethol (p.)	.....	$CH_3 \cdot CH : CH \cdot C_6H_4 \cdot OCH_3$	148.1
2	Angelic acid	.....	$C_4H_7 \cdot COOH$	100.0
3	Anhydroformaldehyde-aniline	.....	$C_6H_5N : CH_2$	105.0
4	Aniline	amino-benzene, phenyl-amine	$C_6H_5 \cdot NH_2$	93.0
5	Anis alcohol (p.)	anisyl alcohol	$CH_3O \cdot C_6H_4 \cdot CH_2 \cdot OH$	138.0
6	Anisaldehyde (p.)	.....	$CH_3O \cdot C_6H_4 \cdot CHO$	136.0
7	Anisic acid (p.)	.....	$CH_3O \cdot C_6H_4 \cdot COOH$	152.0
8	Anisidine (o.)	.....	$CH_3O \cdot C_6H_4 \cdot NH_2$	123.0
9	" (p.)	.....	$CH_3O \cdot C_6H_4 \cdot NH_2$	123.0
10	Anisol	methyl phenyl ether	$C_6H_5 \cdot O \cdot CH_3$	108.0
11	Anthracene	.....	$C_6H_4 : (CH)_2 : C_6H_4$	178.0
12	Anthracenecarboxylic acid (α)	.....	$C_6H_4C_2H(COOH)C_6H_4$	222.0
13	Anthracenecarboxylic acid (β)	.....	$C_6H_4 \cdot C_2H_2 \cdot C_6H_3 \cdot COOH$	222.0
14	Anthracenecarboxylic acid (γ)	.....	$C_6H_4 \cdot C_2H_2 \cdot C_6H_3 \cdot COOH$	222.0
15	Anthrachryson	.....	$C_{14}H_4(OH)_4O_2$	272.0
16	Anthraflavic acid (2, 6)	.....	$C_6H_3(OH)(CO)_2C_6H_3(OH)$	240.0
17	Anthragallol (1, 2, 3)	trihydroxy-anthraquinone	$C_{14}H_5O_2(OH)_3$	256.0
18	Anthramine (β)	β-amino-anthracene	$C_6H_4 : (CH)_2 : C_6H_3 \cdot NH_2$	193.1
19	Anthranil	.....	$C_6H_4 : NH \cdot CO$	119.0
20	Anthranilic acid.	See *o.-amino-benzoic acid*		
21	Anthranol	γ-hydroxy-anthracene	$C_{14}H_{10}O$	194.0
22	Anthrapurpurin	trihydroxy anthraquinone (1, 2, 7)	$C_{14}H_5O_2(OH)_3$	256.0
23	Anthraquinoline	.....	$C_{17}H_{11}N$	229.1
24	Anthraquinone	.....	$C_6H_4 : (CO)_2 : C_6H_4$	208.0
25	Anthrarufin (1, 5)	.....	$C_6H_3(OH)(CO)_2C_6H_3(OH)$	240.0
26	Anthrol (m.)	.....	$C_6H_4 : (CH)_2 : C_6H_3 \cdot OH$	194.0
27	Antimonytriethyl	.....	$Sb(C_2H_5)_3$	208.8
28	Antifebrin.	See *acetanilid*		
29	Antimony pentamethyl	.....	$Sb(CH_3)_5$	196.8
30	trimethyl	.....	$Sb(CH_3)_3$	166.8
31	Antipyrene	analgesine	$C_{11}H_{12}N_2O$	188.1
32	Apomorphine	.....	$C_{17}H_{17}NO_2$	267.1

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form and color	Sp. gr. H_2O = 1 (A)Air = 1	Melting-point °C	Boiling-point °C	Solubility in gms. per 100 c.c. of		
					Water	Alcohol	Ether
1	lvs.	0.994	21.6	233	v. sl. s.	∞	∞
2	monocl.	$0.954^{76°}$	45.5	185	sl. s.	v. s. h	v. s.
3	mic.	.....	d.	.....	.....	sl. s.	.....
4	liquid	$1.022^{20°}$	−6	184.4	$3.1^{16°}$	∞	∞
5	need.	1.113	45	258.8	i.	v. s.	v. s.
6	colorl. liq.	1.126	0	248	sl. s.	∞	∞
7	monocl.	$1.364^{4°}$	184.2	275–80	v. sl. s.; s. h.	v. s.	s.
8	colorl. liq.	1.098	5.2	224	sl. s	.....	.....
9	need. f. h. w.	.....	57.7	239.5	.....	.....	.....
10	colorl. liq.	$0.988^{21°}$	−37.8	155	i.	s.	s.
11	colorl. leaf.	1.147	216.5	351	i.	$0.59^{15°}$	$1.17^{15°}$
12	yel. need.	.....	206 d.	.....	sl. s. h.	s.	.....
13	yel. need.	.....	260	subl.	i.	s.	sl. s.
14	yel. leaf.	.....	abt. 280	subl.	.....	sl. s.	s. glac. acet. a.
15	need. f. al.: yel. leaf. subl.	.....	>360	.....	i.	s.	v. sl. s.
16	yel. need.	.....	>330	subl. d.	i.	sl. s.	i.
17	or. red need.	.....	310	.....	s. alk., green	s.	s.
18	yel. need.	.....	238	.....	v. sl. s	sl. s.	sl. s.
19	colorl.	1.189	18	210–5 d.	s. h. dil. NaOH	v. s.	.....
20							
21	pale yel. need.	.....	160–70 d.	.....	.....	.....	v. s. h. bz.; s alk.
22	or. need. f. al.	.....	abt. 330	.....	sl. s. h.	v. s.	sl. s.
23	leaf.	.....	170	446	i.	v. s.	v. s.; s. bz.
24	pale yel. need.	.....	284.5	380	i	$0.05^{10°}$ $2.3^{70°}$	v. sl. s.
25	yel. lvs.	.....	280	.....	s.	sl. s.	s. bz.
26	need.	.....	d. 200	.....	s. acet.	v. s.	v. s.
27	liq.	$1.324^{16°}$	.....	158	i.	s.	s.
28							
29	.....	.....	.....	96–100	i.	.....	.....
30	.....	1.523	.....	80.6	sl. s.	i.	s.
31	leaf.	$1.19^{20°}$	111–13	.....	100+	100	3.3
32	wh. amor.	.....	.....	.....	sl. s.	s.	s.; sl. s. HCl.

No.	Name	Synonyms	Formula	Mol. wt.
1	Apoquinine	.....	$C_{19}H_{22}N_2O_2 + 2H_2O$	346.22
2	Arabinic acid	.....	$(C_5H_{10}O_5)_2 \cdot H_2O$	342.18
3	Arabinose (d. or l.)	.....	$C_5H_{10}O_5$	150.08
4	Arabitol	arabite	$C_5H_{12}O_5$	152.10
5	Arabonic acid	.....	$HO \cdot CH_2(CHOH)_3 COOH$	166.08
6	Arachidic acid	arachic acid	$C_{20}H_{40}O_2$	312.32
7	Arbutin	.....	$C_{12}H_{16}O_7 + \frac{1}{2}H_2O$*	281.14
8	Arsenic diethyl	.....	$As(C_2H_5)_2$	133.04
9	Arsenic triethyl	.....	$As(C_2H_5)_3$	162.08
10	Arsenic trimethyl	.....	$As(CH_3)_3$	120.03
11	Asparagine (l.)	.....	$C_2H_3(NH_2)(COOH) \cdot CO \cdot NH_2$	132.08
12	Aspartic acid	.....	$CH(NH_2) \cdot COOH$ $CH_2 \cdot COOH$	133.06
13	Aspirin	acetyl-salicylic acid	$C_6H_4 < O \cdot COCH_3$ $COOH$	180.06
14	Atrolactic acid	.....	$CH_3 \cdot C(C_6H_5)(OH) COOH + \frac{1}{2}H_2O$	175.09
15	Atropic acid	.....	$CH_2 : C(C_6H_5) \cdot COOH$	148.06
16	Atropine	dauterine, inactive tropine	$C_{17}H_{23}O_3N$	289.19
17	Atropine sulfate	.....	$(C_{17}H_{23}O_3N)_2H_2SO_4$	676.45
18	Auramine	.....	$HN : C[C_6H_4 \cdot N(CH_3)_2]_2$	267.19
19	Aurine	coralline	$C_{19}H_{14} \cdot O_3$	290.11
20	Azelaic acid	.....	$COOH \cdot (CH_2)_7 \cdot COOH$	188.13
21	Azobenzene	.....	$C_6H_5 \cdot N_2 \cdot C_6H_5$	182.10
22	Azobenzoic acid (o.)	.....	$COOH \cdot C_6H_4 \cdot N_2 \cdot C_6H_4 \cdot COOH$	270.10
23	Azobenzoic acid (m.)	.....	$C_{14}H_{10}N_2O_4 + \frac{1}{2}H_2O$	279.10
24	Azobenzoic acid (p.)	.....	$C_{14}H_{10}N_2O_4 + \frac{1}{2}H_2O$	279.10
25	Azodicarbonamide	.....	$NH_2 \cdot CON_2CO \cdot NH_2$	116.06
26	Azodinaphthylamine (α)	.....	$C_{10}H_7 \cdot N_2 \cdot C_{10}H_6 \cdot NH_2$	297.14
27	Azonaphthalene (α, α)	.....	$C_{10}H_7 \cdot N_2 \cdot C_{10}H_7$	282.13
28	Azophenetol (o.)	.....	$(C_6H_4OC_2H_5)_2N_2$	270.16
29	" (p.)	.....	$(C_6H_4OC_2H_5)_2N_2$	270.16
30	Azophenol (o.)	dihydroxy-azobenzene (2, 2′)	$HO \cdot C_6H_4 \cdot N_2 \cdot C_6H_4 \cdot OH$	214.10
31	" (m.)	dihydroxy-azobenzene (3, 3′)	$HO \cdot C_6H_4 \cdot N_2 \cdot C_6H_4 \cdot OH$	214.10
32	" (p.)	dihydroxy-azobenzene (4, 4′)	$HO \cdot C_6H_4 \cdot N_2 \cdot C_6H_4 \cdot OH$	214.10
33	Azotoluene (o.)	dimethyl-azobenzene (2, 2′)	$CH_3 \cdot C_6H_4 \cdot N_2 \cdot C_6H_4 \cdot CH_3$	210.13
34	" (m.)	dimethyl-azobenzene (3, 3′)	$CH_3 \cdot C_6H_4 \cdot N_2 \cdot C_6H_4 \cdot CH_3$	210.13

* Other authorities give $C_{25}H_{34}O_{14}$ and m.p. 144–166° C.

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form and color	Sp. gr. H_2O = 1 (A)Air = 1	Melting-point °C	Boiling-point °C	Solubility in gms. per 100 c.c. of		
					Water	Alcohol	Ether
1	need. f. eth.	.....	210	.....	s. h.	s.	v. s.; s. chl.; s. bz.; s. CS_2
2	.....	.....	.....	.....	v. s.	sl. s.	.....
3	rhomb.	.....	abt. 160	.....	59^{100}	v. sl. s.	i.
4	colorl. warts.	.....	102	.....	v. s.	v. s. h.	.....
5	micr. need.	.....	89	.....	s.	.....	.....
6	lvs.	.....	77	.....	i.	$0.45^{20°}$	v. s.
7	need.	.....	165–70	.....	v. s. h.	v. s.	i.
8	liq.	$>H_2O$	.....	185–90	i.	s.	s.
9	liq.	$1.15^{15°}$	.....	140	i.	.....	.....
10	liq.	.....	.....	<100	.....	.....	.....
11	rhomb.	1.543	230–5 d.	.....	$1.8^{100°}$ $53^{100°}$	i.	i.
12	leaf.	.....	290.4 d.	.....	$0.39^{100°}$ $5.4^{100°}$	i. abs.	.....
13	colorl. cryst.	.....	135	.....	sl. s.	s.	s.
14	rhomb.	.....	90; anh. 93	.....	s.	.....	.....
15	monocl. tab.	.....	106–6	267 d.	$0.14^{19°}$	s.	s. CS_2
16	need.	.....	115–115.5	.....	$0.22^{25°}$	68.5	6
17	wh. powd.	.....	188	.....	260	27	0.05
18	yel. leaf. f. al.	.....	136	.....	i.	s.	.....
19	red need.	.....	abt. 220	.....	i.; s. alk.	s.	s.
20	leaf.	.....	106	abt. 360 d.	$0.24^{20°}$ v. s. h.	v. s.	2.7
21	or. leaf.	1.203	68	295–7	i.	$8.5^{16°}$	s.
22	dk. yel. need.	.....	237 d.	.....	v. sl. s.	s.	v. s.
23	wh. amor.	.....	.....	d.	sl. s.	sl. s.	sl. s.
24	red amor.	.....	.....	d.	sl. s.	sl. s.	sl. s.
25	red cryst.	.....	180 d.	.....	sl. s.	i.	.....
26	red need.	.....	.....	(135) 174	i.	sl. s.	s. H_2SO_4
27	red need.	.....	186–90	subl.	i.	sl. s.	s. bz.
28	red pr.	.....	131	240 d.	i.	s.	s.; s. HCl
29	yel. leaf.	.....	160	d.	i.	s. h.	v. s.
30	yel. leaf.	.....	171	subl.	i.; s. alk.	0.33	v. s.
31	br. leaf.	.....	205	.....	v. sl. s.	s.	sl. s.
32	br. triclin.	.....	204 d.	.....	sl. s.	v. s.	v. s.; s. bz.
33	red pr.	.....	55	.....	i.	$6^{14.5°}$	$147.7^{16.5°}$
34	or. red rhomb.	.....	54–5	.....	i.	v. s.	v. s.

No.	Name	Synonyms	Formula	Mol. wt.
1	Azotoluene (p.) ..	dimethyl-azobenzene (4, 4')	$CH_3 \cdot C_6H_4 \cdot N_2 \cdot C_6H_4 \cdot CH_3$	210.13
2	Azoxybenzene....	.....	$(C_6H_5)_2 : N_2O$.....	198.10
3	Azoxybenzoic acid (o.)	.....	$(COOH \cdot C_6H_4)_2N_2O$	286.10
4	Azoxybenzoic acid (m.)	.....	$(COOH \cdot C_6H_4)_2N_2O$	286.10
5	Azoxybenzoic acid (p.)	.....	$(COOH \cdot C_6H_4)_2N_2O$	286.10
6	Azoxynaphthalene (α)	.....	$(C_{10}H_7)_2N_2O$.....	298.13
7	Baphitn.....	.....	$C_{12}H_{10}O_4$.....	218.08
8	Barbituric acid...	malonyl urea.....	$CO : (NH \cdot CO)_2 : CH_2 + 2H_2O$	164.08
9	Basilicum camphor	.....	$C_{10}H_{16} + 3H_2O$.....	190.18
10	Bassorine.....	.....	$C_{16}H_{10}O_5$.....	282.08
11	Bebeerine.....	.....	$C_{18}H_{21}NO_3$.....	299.18
12	Behenic acid.....	.....	$C_{22}H_{44}O_2$.....	340.35
13	Behenolic acid...	.....	$C_{22}H_{40}O_2$.....	336.32
14	Benzalacetone....	benzylidene-acetone	$C_6H_5C_2H_2COCH_3$...	146.08
15	Benzal-acetophenone	chalkon.....	$C_6H_5C_2H_2 \cdot CO \cdot C_6H_5$	208.10
16	azine.....	.....	$C_6H_5CH : N \cdot N : CH \cdot C_6H_5$	208.11
17	chloride.....	benzylidene chloride	$C_6H_5 \cdot CHCl_2$.....	160.96
18	cyanhydrine....	mandelic nitrile...	$C_6H_5 \cdot CH(OH) \cdot CN$	133.06
19	Benzaldehyde....	art. almond oil...	$C_6H_5 \cdot CHO$.....	106.05
20	phenylhydrazone	.....	$C_6H_5 \cdot CH : N \cdot NH \cdot C_6H_5$	196.11
21	sulfonic acid (α)	.....	$C_6H_5(CHO) \cdot SO_3H$..	187.12
22	Benzaldoxime (α) (anti.)	.....	$C_6H_5 \cdot CH : NOH$...	121.06
23	Benzaldoxime (β) (syn.)	.....	$C_6H_5 \cdot CH : NOH$...	121.06
24	Benzaldoxime carboxylic anhydride (o.)	benzoxazinone.....	$C_6H_4 \cdot CH : NO \cdot CO$	147.05
25	Benzalhydrazine..	benzylidenehydrazine	$C_6H_5 \cdot CH : N \cdot NH_2$..	120.08
26	Benzalmalonic acid	.....	$C_6H_5 \cdot CH : C(COOH)_2$	192.06
27	Benzamaron.....	.....	$C_6H_5 \cdot CH[CH \cdot (C_6H_5)COC_6H_5]_2$	480.22
28	Benzamide.....	.....	$C_6H_5 \cdot CONH_2$.....	121.06
29	Benzaurine.....	.....	$C_6H_5 \cdot C(:C_6H_4O) \cdot C_6H_4OH$	274.11
30	Benzamidine.....	benzenylamidine..	$C_6H_5C(NH)NH_2$....	120.08
31	Benzanilide.....	phenyl benzamide	$C_6H_5 \cdot CO \cdot NH \cdot C_6H_5$	197.10
32	Benzazide.....	benzoylazide.....	$C_6H_5 \cdot CON_3$.....	147.06

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form and color	Sp. gr. H_2O = 1 (A)Air = 1	Melting-point °C	Boiling-point °C	Solubility in gms. per 100 c.c. of		
					Water	Alcohol	Ether
1	or. yel. need.	.....	144	.....	i.; s. lgr.	s.	v. s.
2	yel. need. f. h. al.	$1.248^{\frac{23°}{23°}}$	36.2	d.	i.	$17.5^{16°}$	v. s.
3	pa. yel. leaf.	.....	248	dec.	v. sl. s. h.	sl. s.	sl. s.
4	pa. yel. need.	.....	320 d.	.....	i.	sl. s.	sl. s.
5	yel. amor.	.....	dec.	.....	i.	i.	s. pyr.
6	red rhomb.	.....	126.5–7.0	.....	s. cone. H_2SO_4	s.	.....
7	leaf.	.....	.....	.....	i.	s.	s.
8	rhombs.	.....	d.	.....	sl. s.	.....	.....
9	pr.	.....	.....	.....	s. h.	s.	1 : 6
10	amor.	.....	.....	.....	sl. s.	.....	.....
11	powd.	.....	214	.....	sl. s	s.	s.
12	colorl. need.	.....	84	.....	i.	$0.10^{17°}$	$1.92^{16°}$
13	need.	.....	56.5	.....	i.	v. s. abs.	.....
14	tetr. pl.	1.008	42	262	i.	s.	s.
15	rhomb. pl.	.....	58	347	i.	.....	s. petr. eth.
16	yel. pr.	.....	93	d.	i.	v. s. h.	v. s.
17	colorl. liq.	$1.295^{16°}$	–16	213	i.	∞	∞
18	liq.	1.124	–10	d 170	i.	s.	s.
19	colorl. liq.	1.05	–13.5	179.5	0.33	∞	∞
20	colorl.–pink	.....	154.5–155.5	.....	.....	.....	.....
21	.....	.....	114	.....	s.	.....	.....
22	colorl. leaf.	$1.11^{20°}$	33–5	118–9 10mm.	sl. s.	v. s.	v. s.
23	colorl. tab. or need.	.....	128–30	.....	sl. s. bz.	.....	v. s.
24	.....	.....	145 d. to	$C_6H_4(CN)COOH$			.....
25	.....	.....	16	140	.....	s.	.....
26	pr. f. w.	d. to cinnamic acid		.....	s. h.	s.	sl. s.
27	.....	.....	219; iso-180	.....	1 : 157 h.	sl. s.	.....
28	colorl. monocl.	$1.341^{4°}$	128	290	sl. s. h.	$27^{25°}$	v. s.
29	red cryst.	.....	100	.....	sl. s.	s.	s.
30	cryst.	.....	75–80	.....	s.	v. s.	sl. s.
31	colorl. leaf.	$1.324^{0°}$	160–1	.....	i.	1.7 c.; 14.3 h.	sl. s.
32	pr.	.....	29–30	.....	i.	v. s.	v. s

No.	Name	Synonyms	Formula	Mol. wt.
1	Benzene		C_6H_6	78.05
2	azo-α-naphthylamine		$C_6H_5 \cdot N_2 \cdot C_{10}H_6 \cdot NH_2$	247.13
3	hexabromide (α)		$C_6H_6Br_6$	557.54
4	hexachloride (α)		$C_6H_6Cl_6$	290.79
5	" (β)		$C_6H_6Cl_6$	290.79
6	indone	aposafranone	$C_{18}H_{12}N_2O$	272.11
7	pentacarboxylic acid		$C_6H(COOH)_5$	298.05
8	sulfide		$(C_6H_5)_2S$	186.14
9	sulfinic acid		$C_6H_5 \cdot SO_2H$	142.11
10	sulfonic acid		$C_6H_5 \cdot SO_3H + 1\frac{1}{2}H_2O$	185.14
11	sulfonic amide		$C_6H_5 \cdot SO_2NH_2$	157.13
12	sulfonic chloride		$C_6H_5 \cdot SO_2Cl$	176.56
13	sulfoxide		$(C_6H_5)_2SO_2$	218.14
14	trisulfonic acid		$C_6H_3(SO_3H)_3$	318.24
15	Benzenylaminoxime		$C_6H_5C(NOH)NH_2$	136.08
16	Benzenylaminothiophenol	μ-phenylbenzothiazole		211.14
17	Benzenylnaphthylamidine		$C_6H_5C(NH)NH \cdot C_{10}H_7$	246.13
18	Benzenylphenyleneamidine			194.10
19	Benzhydrolether		$[(C_6H_5)_2CH]_2O$	350.18
20	Benzhydroxamic acid		$C_6H_5C(NOH)OH$	137.06
21	Benzhydrylamine		$(C_6H_5)_2CH \cdot NH_2$	183.11
22	Benzhydrylbenzoic acid (p.)		$C_6H_5CH(OH) \cdot C_6H_4COOH$	228.10
23	Benzidine (p.)	4, 4′-diamino-diphenyl (p.)	$NH_2 \cdot C_6H_4 \cdot C_6H_4 \cdot NH_2$	184.11
24	disulfonic acid (o.)		$(NH_2)_2C_{12}H_6(SO_3H)_2$	344.24
25	sulfone		$C_{12}H_6(NH_2)_2SO_2$	246.16
26	Benzil	dibenzoyl	$C_6H_5 \cdot CO \cdot CO \cdot C_6H_5$	210.08
27	Benzilam	triphenyloxazole		297.13
28	Benzilosazone		$(C_6H_5C)_2(N \cdot NH \cdot C_6H_5)_2$	390.21
29	Benzildioxime (α)		$C_6H_5 \cdot C_2(NOH)_2C_6H_5$	240.11
30	" (β)		$C_6H_5 \cdot C_2(NOH)_2C_6H_5$	240.11
31	" (γ)		$C_6H_5 \cdot C_2(NOH)_2C_6H_5$	240.11
32	Benziloxime (α)		$C_6H_5CO \cdot C(NOH)C_6H_5$	225.10
33	" (γ)		$C_6H_5CO \cdot C(NOH)C_6H_5$	225.10

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form and color	Sp. gr. $H_2O = 1$ (A)Air = 1	Melting-point °C	Boiling-point °C	Solubility in gms. per 100 c.c. of		
					Water	Alcohol	Ether
1	colorl. rhomb. prisms	$0.879^{20°}$	5.4	80.36	$0.07^{22°}$	∞	∞
2	red need.	.....	123	.....	s. bz.	s.	s.
3	colorl. monocl.	.....	212	.....	.....	sl. s.	sl. s.
4	colorl. monocl.	$1.87^{20°}$	157	218 (345mm.)	$4.35^{15°}$ chl.	$6.5^{18°}$ bz.	v. s. aniline
5	colorl.	.....	310	subl.	(Less s.	than α in chl.)	
6	red cryst.	.....	242	.....	sl. s.	s.	s. bz.
7	.....	.....	.....	d.	v. s.	.....	.....
8	liq.	1.12	.....	292	i.	s.	s.
9	prisms	.....	83–4	d. 100	s. h.	v. s.	v. s.
10	colorl. leaf.	.....	65–6	.....	v. s.	v. s.	i.
11	lust. pl.	.....	150	.....	sl. s.	v. s.	v. s.
12	oil	1.384	14.5	251.5	i.	v. s.	s.
13	.....	.....	128	subl.	i.	s.	s.
14	cryst. $+ 3H_2O$	.....	.....	.....	deliq.	.....	.....
15	pr.	.....	79	.....	s. h.	s.	s.
16	need. f. al.	.....	115	360	i.	s.	s.
17	pl.	.....	141	.....	i.	s.	.....
18	rhomb. pl.	.....	280	.....	sl. s.	s.	s. glac. acet. a.
19	monocl. f. bz.	.....	109–11	315	.....	sl. s.	sl. s.; s. bz.
20	rhomb. lvs. or pl.	.....	124–5	.....	$1:44.5^{6°}$	s.	sl. s.
21	hex. pl.	.....	.....	295	.....	.....	.....
22	need.	.....	164–5	d.	s. h.	s.	s.
23	lust. scales f. h. w.	.....	128.2–30.7	400–1 (740mm.)	$0.94^{100°}$	s.	2.2
24	leaf.	.....	.....	.....	sl. s.	sl. s.	sl. s.
25	yel. amor.	.....	300 d.	.....	i.	i.	i.
26	yel. need.	.....	95	346–8 d.	i.	v. s.	v. s.
27	rhomb. pr.	.....	115	.....	.....	sl. s.	sl. s.
28	need.	.....	225	.....	i.	sl. s.	sl. s.
29	leaf.	.....	237	.....	i.	sl. s.	i.
30	need.	.....	206	.....	sl. s. h.	sl. s.	s.
31	need.	.....	165	.....	.....	s.	.....
32	leaf.	.....	137	.....	sl. s.	v. s.	v. s.
33	need.	.....	114	.....	.....	s.	s.

No.	Name	Synonyms	Formula	Mol. wt.
1	Benzilic acid		$(C_6H_5)_2C(OH)\cdot COOH$	228.10
2	Benzimidazole (o.)		$C_6H_4\cdot N:CH\cdot NH$	118.06
3	Benzimidazolone (o.)	phenylene urea	$C_6H_4\cdot NH\cdot CO\cdot NH$	134.06
4	Benzoic acid		$C_6H_5\cdot COOH$	122.05
5	anhydride		$(C_6H_5\cdot CO)_2O$	226.08
6	Benzoin		$C_6H_5\cdot CH(OH)\cdot CO\cdot C_6H_5$	212.10
7	Benzoin ethyl ether		$C_6H_5\cdot CH(OC_2H_5)\cdot CO\cdot C_6H_5$	240.13
8	Benzonitrile	phenyl cyanide	$C_6H_5\cdot CN$	103.05
9	Benzophenone	diphenyl ketone	$C_6H_5\cdot CO\cdot C_6H_5$	182.08
10	dicarboxylic acid		$CO:(C_6H_4\cdot COOH)_2$	270.08
11	oxime		$(C_6H_5)_2C:NOH$	197.10
12	Benzophosphinic acid (p.)		$COOH\cdot C_6H_4\cdot PO(OH)_2$	202.08
13	Benzopinacone		$(C_6H_5)_2\cdot C(OH)\cdot C(OH)(C_6H_5)_2$	366.19
14	Benzoquinone	See *quinone*		
15	Benzothiophene	See *thio naphthene*		
16	Benzotichloride	toluene trichloride	$C_6H_5\cdot CCl_3$	195.41
17	Benzoyl-acetic acid		$C_6H_5\cdot CO\cdot CH_2\cdot COOH$	164.06
18	acetone		$C_6H_5\cdot CO\cdot CH_2\cdot CO\cdot CH_3$	162.08
19	acetonitrile		$C_6H_5\cdot CO\cdot CH_2\cdot CN$	145.06
20	aminobenzoic acid (o.)		$NH\cdot(C_7H_5O)\cdot C_6H_4COOH$	241.10
21	aminobenzoic acid (m.)		$NH\cdot(C_7H_5O)\cdot C_6H_4COOH$	241.10
22	aminobenzoic acid (p.)		$NH\cdot(C_7H_5O)\cdot C_6H_4COOH$	241.10
23	benzoic acid (o.)		$C_6H_5\cdot CO\cdot C_6H_4COOH + H_2O$	244.10
24	" " (m.)		$C_6H_5\cdot CO\cdot C_6H_4COOH$	226.08
25	" " (p.)		$C_6H_5\cdot CO\cdot C_6H_4COOH$	226.08
26	bromide		$C_6H_5\cdot COBr$	184.96
27	chloride		$C_6H_5\cdot COCl$	140.50
28	cyanide		$C_6H_5\cdot COCN$	131.05
29	disulfide		$(C_6H_5\cdot CO)_2S_2$	274.21
30	fluoride		$C_6H_5\cdot COF$	124.04
31	formic acid		$C_6H_5\cdot CO\cdot COOH$	150.05
32	glycolic acid		$C_7H_5O\cdot OCH_2\cdot COOH$	180.06
33	hydrazine		$C_6H_5\cdot CO\cdot NH\cdot NH_2$	136.08
34	hydrogenperoxide		$C_6H_5\cdot CO\cdot O_2H$	138.05
35	iodide		$C_6H_5\cdot COI$	231.97
36	lactic acid		$CH_3\cdot CH(OC_7H_5O)\cdot COOH$	194.08

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form and color	Sp. gr. $H_2O = 1$ (A)Air = 1	Melting-point °C	Boiling-point °C	Solubility in gms. per 100 c.c. of		
					Water	Alcohol	Ether
1	monocl.	.....	150	.....	v. s. h.	v. s.	v. s.
2	need.	.....	170	.....	s.	s.	s.
3	leaf.	.....	305	.....	sl. s.	s.	.....
4	colorl. leaf. or need.	1.266	121.2	249.2	$0.29^{20°}$ $5.9^{100°}$	$47^{15°}$ abs	31.4
5	colorl. rhomb.	1.199	42	360	.....	s.	s.
6	hex. f. al.	.....	133–7	343–4	i. c.; sl. s. h.	s. h.	.....
7	pr.	.....	95	184–6	.....	s.	s.
8	liq.	$1.000^{25°}$	−13.1	191	$^{100°}$	∞	∞
9	colorl. rhomb.	$1.098^{50°}_{50°}$	(27) 48.0–.5	306	i.	$13.5^{18°}$	$17.5^{13°}$
10	gelat.	.....	>300	.....	i.	s.	.....
11	need.	.....	140	.....	i.	s.	s. alk.
12	need.	.....	>300	.....	s.	s.	.....
13	pr.	.....	168	.....	.....	s. h. 1 : 39	s.
14							
15							
16	colorl. oil	1.38	−21.2	213–4	dec.	.....	.....
17	colorl. need.	.....	103–4, d.	.....	sl. s.	v. s.	v. s.
18	colorl.	.....	60–1	.....	v. sl. s.	v. s.	v. s.
19	need.	.....	80.5	.....	.....	s.	s.
20	l. need. f. al.	.....	182	.....	i.	s.	s.
21	red cryst.	$1.5105^{4°}$	174	subl.	sl. s. c.; s. h.	s.	s.
22	sm. need. f. al.	.....	278	.....	sl. s.	s.	s.
23	tricl. need.	.....	85–7	.....	s. h.	.....	.....
24	l. need.	.....	161–2	.....	sl. s.	s.	s.
25	monocl. lvs. f. w.	.....	.....	subl.	sl. s.	s.	s.
26	colorl. liq.	1.570	abt. 0	218	d.	s. v. s.	∞
27	colorl. liq.	1.219	−1	198	d.	d.	∞
28	colorl. tab.	.....	32–3	206.8	i.	.....	.....
29	pr.	.....	128	d.	i.	sl. s.	sl. s.; s. CS_2
30	liq.	$>H_2O$	.....	161.5	.....	.....	.....
31	cryst.	.....	65–6	.....	s.	s.	s.
32	lg. pr.	.....	.....	.....	sl. s. c.; s. h.	s.	s.
33	pl.	.....	112.5	267	v. s.	v. s.	sl. s.
34	cryst.	.....	42	expl.	sl. s.	.....	.....
35	lvs.	.....	d.	.....	d.	s.	.....
36	pl.	.....	112	.....	1 : 400 c.; s. h.	s	s

No.	Name	Synonyms	Formula	Mol. wt.
1	Benzoyl-peroxide		$(C_6H_5 \cdot CO)_2O_2$	242.08
2	phenylhydrazine (α)		$C_6H_5 \cdot CO \cdot NH \cdot NH \cdot C_6H_5$	212.11
3	phthalic acid (1, 2, 3)		$C_6H_5 \cdot CO \cdot C_6H_3(COOH)_2$	270.08
4	propionic acid (β)		$C_6H_5 \cdot CO \cdot CH_2 \cdot CH_2 \cdot COOH$	178.08
5	terephthalic acid		$C_6H_5 \cdot CO \cdot C_6H_3(COOH)_2$	270.08
6	tetramethylene		$C_6H_5 \cdot CO \cdot CH(CH_2)_3$	160.10
7	thiourea		$NH_2CSNH(C_7H_5O)$	180.14
8	toluide (o.)		$C_7H_5O \cdot NH \cdot C_6H_4 \cdot CH_3$	211.11
9	" (p.)		$C_7H_5O \cdot NH \cdot C_6H_4 \cdot CH_3$	211.11
10	Benzpinacone		$(C_6H_5)_2C(OH) \cdot C(OH)(C_6H_5)_2$	366.18
11	Benzyl-acetamide		$C_7H_7 \cdot NH(C_2H_3O)$	149.10
12	acetate		$CH_3 \cdot COO \cdot CH_2 \cdot C_6H_5$	150.08
13	aniline		$C_7H_7 \cdot NH \cdot C_6H_5$	183.11
14	azide		$C_6H_5 \cdot CH_2N_3$	133.08
15	aceto-acetic ether		$C_2H_3O \cdot CH(C_7H_7)COOC_2H_5$	220.13
16	alcohol	phenyl carbinol	$C_6H_5 \cdot CH_2OH$	108.06
17	amine		$C_6H_5 \cdot CH_2 \cdot NH_2$	107.08
18	benzoic acid (o.)		$C_6H_5 \cdot CH_2 \cdot C_6H_4 COOH$	212.10
19	" (p.)		$C_6H_5 \cdot CH_2 \cdot C_6H_4 COOH$	212.10
20	benzoate		$C_6H_5 \cdot COOCH_2 \cdot C_6H_5$	212.10
21	bromide		$C_6H_5 \cdot CH_2 \cdot Br$	170.97
22	carbamate		$NH_2 \cdot COOC_7H_7$	151.08
23	carbinol.	See *phenyl ethyl alcohol*		
24	chloride		$C_6H_5 \cdot CH_2Cl$	126.51
25	cinnamate	cinnamein	$C_9H_7O_2C_7H_7$	238.11
26	cyanamide		C_7H_7NHCN	132.08
27	cyanide		$C_6H_5 \cdot CH_2CN$	117.06
28	cyanurate		$(C_7H_7NCO)_3$	399.19
29	diphenyl (o.)		$C_6H_5 \cdot CH_2 \cdot C_6H_4 \cdot C_6H_5$	244.13
30	" (p.)		$C_6H_5 \cdot CH_2 \cdot C_6H_4 \cdot C_6H_5$	244.13
31	diphenylamine		$C_7H_7 \cdot N(C_6H_5)_2$	259.14
32	disulfide		$(C_6H_5 \cdot CH_2)_2S_2$	246.24
33	ether		$(C_6H_5 \cdot CH_2)_2O$	198.11
34	hydrazine		$C_6H_5 \cdot CH_2 \cdot NH \cdot NH_2$	122.10
35	hydroxylamine (α)		$C_6H_5 \cdot CH_2 \cdot NHOH$	123.08
36	hydroxylamine (β)		$C_6H_5 \cdot CH_2 \cdot NHOH$	123.08
37	iodide		$C_6H_5 \cdot CH_2I$	217.99
38	mercaptan		$C_6H_5 \cdot CH_2 \cdot SH$	124.13

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form and color	Sp. gr. $H_2O = 1$ (A)Air = 1	Melting-point °C	Boiling-point °C	Solubility in gms. per 100 c.c. of		
					Water	Alcohol	Ether
1	colorl. rhomb.	.....	103.5	.....	i.; s. bz.	s.	v. s.
2	colorl.	.....	168	.....	v. sl. s. h.	s. h.	v. sl. s
3	pl.	.....	155	.....	s. h.	s.	.....
4	need.	.....	116	.....	s. h.	s.	.....
5	.....	.....	250	.....	i.	s.	.....
6	.....	.....	.....	258	.....	.....	.....
7	sm. pr.	.....	169–70	.....	sl. s.	s.	i.
8	need.	.....	142–3	.....	sl. s. h.	s.	.....
9	l. need.	.....	155	.....	.....	s.	s.
10	pr.	.....	185	.....	.....	.....	.....
11	leaf.	.....	(30) 57	300	i.	s.	s.
12	colorl. liq.	$1.057^{16°}$	.....	206	v. sl. s.	∞	∞
13	pr. fr. al.	.....	32	$200^{50mm.}$	.....	s.	.....
14	.....	.....	.....	$74^{11mm.}$	.....	.....	.....
15	colorl. liq.	$1.061\frac{16°}{4°}$	.....	284–90	i.	∞	∞
16	colorl. liq.	$1.043^{20°}$	.....	204.7	$4^{17°}$	∞	∞
17	colorl. liq.	$0.980^{20°}$	.....	184	∞	∞	∞
18	need.	.....	114	subl.	sl. s.	s.	s.
19	need. f. w.	.....	154–5	subl.	sl. s.	v. s.	v. s.
20	colorl. liq. or leaf.	$1.114^{19°}$	18.3	323–4	i.	s.	∞
21	liq.	$1.438^{22°}$	−3.9	198.5	i.	∞	∞
22	leaf.	.....	86	d.	sl. s.	s.	s.
23							
24	colorl. liq.	$1.103^{18°}$	−41.2	176–9	i.	∞	∞
25	pr.	.....	39	dist. in vac.	.....	.....	.....
26	leaf.	.....	33	.....	i.	s.	s.
27	liq.	$1.021\frac{16°}{4°}$	−24.6	233.5	i.	∞	∞
28	need.	.....	157	>320	i.	s.	sl. s.
29	monocl. need.	.....	54	283–87	.....	s.	s.
30	leaf.	.....	85	285–6	.....	s.	s.
31	.....	.....	87	.....	.....	sl. s. c.	.....
32	leaf.	.....	71	.....	.....	sl. s. c.; v. s. h.	sl. s.
33	colorl. oil	$1.036^{16°}$	.....	295–8	.....	v. s. h.	s
34	.....	.....	.....	$103^{41mm.}$	.....	.....	.....
35	.....	.....	.....	$123^{50mm.}$	.....	.....	.....
36	.....	.....	57	.....	.....	.....	.....
37	.....	$1.734^{25°}$	24	d.	s. CS_2	sl. s.	s.
38	liq.	$1.058^{20°}$	.....	194.5	.....	.....	.....

No.	Name	Synonyms	Formula	Mol. wt.
1	Benzyl-mustard oil	benzyl-isothiocyanate	$C_6H_5 \cdot CH_2 \cdot NCS$	149.13
2	naphthalene (α)		$C_6H_5 \cdot CH_2 \cdot C_{10}H_7$	218.11
3	" (β)		$C_6H_5 \cdot CH_2 \cdot C_{10}H_7$	218.11
4	naphthylketone		$C_6H_5 \cdot CH_2 \cdot CO \cdot C_{10}H_7$	246.11
5	phenanthracene		$C_7H_7 \cdot C_6H_3 \cdot C_2H_2 \cdot C_6H_4$	268.13
6	phenol (p.)		$C_6H_5 \cdot CH_2 \cdot C_6H_4OH$	184.10
7	pyridine (α)		$C_6H_5 \cdot CH_2 \cdot C_5H_4N$	169.10
8	" (β)		$C_6H_5 \cdot CH_2 \cdot C_5H_4N$	169.10
9	sulfide		$(C_7H_7)_2S$	214.18
10	sulfone		$(C_7H_7)_2SO_2$	
11	sulfoxide		$(C_7H_7)_2SO$	246.18
12	tartronic acid		$C_7H_7 \cdot C(OH)(COOH)_2$	230.18
13	thiourea		$NH_2CSNH(C_7H_7)$	210.08
14	toluene (m.)		$C_7H_7 \cdot C_6H_4 \cdot CH_3$	166.16
15	" (p.)		$C_7H_7 \cdot C_6H_4 \cdot CH_3$	182.11
16	urea	benzyl carbamide	$C_6H_5 \cdot CH_2 \cdot NH \cdot CO \cdot NH_2$	182.11 150.10
17	Benzylideneaniline	benzalaniline	$C_6H_5 \cdot CH : N \cdot C_6H_5$	
18	Benzylidene bromide	benzalbromide	$C_6H_5 \cdot CHBr_2$	181.10 249.88
19	Benzylidenephenylhydrazine		$C_6H_5 \cdot CH : N \cdot NH \cdot C_6H_5$	196.11
20	Benzylidenephthalide		$C_6H_5 \cdot CHC \cdot C_6H_4 \cdot CO \cdot O$	222.08
21	Berberine		$C_{20}H_{17}O_4N + 6H_2O$	443.24
22	Berberonic acid	pyridine tricarboxylic acid (2, 4, 5)	$C_5H_5N(COOH)_3$ (2, 4, 5) $+ 2H_2O$	250.10
23	Betaine	trimethylglycine	$CO \cdot CH_2 \cdot N(CH_3)_2 \cdot O$	117.10
24	Betol	naphthosalol	$C_{10}H_7O \cdot CC \cdot C_6H_4(OH)$	264.10
25	Betulin		$C_{36}H_{60}O_3$	540.48
26	Betulinic acid		$C_{36}H_{54}O_6$	582.43
27	Bilifuscin		$C_{16}H_{10}N_2O_2$	294.10
28	Bilirubin		$C_{34}H_{36}N_4O_7$	612.32
29	Biliverdin		$C_{32}H_{36}N_4O_8$	604.32
30	Bismuthtriethyl		$Bi(C_2H_5)_3$	296.12
31	Biuret		$NH_2 \cdot CO \cdot NH \cdot CO \cdot NH_2 \cdot + H_2O$	121.08
32	Borneol (i.)		$C_{10}H_{17}OH$	154.14
33	" (d.)	Borneo camphor	$C_{10}H_{17}OH$	154.14
34	" acetate (d.)		$CH_3 \cdot COOC_{10}H_{17}$	196.16
35	Bornylamine		$C_{10}H_{17}NH_2$	153.16

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form and color	Sp. gr. $H_2O = 1$ (A)Air = 1	Melting-point °C	Boiling-point °C	Solubility in gms. per 100 c.c. of		
					Water	Alcohol	Ether
1	.....	.....	.....	243	i.	.....	s.
2	monocl. pr. f. al.	1.166$^{17°}$	58.6	330–40	.....	1 : 30 h.	1 : 2
3	monocl.	1.176	55	345	.....	1 : 44	s. bz.
4	pl. f. al.	.....	57	.....	.....	s.	s.
5	need. f. bz.	.....	155–6	.....	.....	sl. s.	sl bz.
6	need.	.....	84	325	.....	s.	.....
7	.....	.....	.....	276	.....	.....	.....
8	.....	.....	34	287	.....	.....	.....
9	rhomb. pl. f. eth.	.....	49	.....	i.	s.	s.
10	need.	.....	150	.....	.....	sl. s. c.	s. bz.
11	leaf.	.....	130–3	.....	i. c.; s. h.	s.	s.
12	pr.	.....	143	d.	s.	s.	.....
13	.....	.....	101	.....	s.	.....	.....
14	liq.	0.997$^{17.5°}$	.....	268–9.5	.....	s.	s.
15	liq.	0.995$^{17.5°}$	.....	279–80	.....	s.	s.
16	need.	.....	147	.....	sl. s.	v. s.	sl. s.
17	yel. need.	.....	45	.....	i.	s.	s.
18	.....	.....	.....	130$^{20mm.}$	.....	.....	.....
19	monocl. pr.	.....	152.5	.....	.....	s. h.	sl. s.
20	.....	.....	99; iso. 91	.....	.....	.....	.....
21	yel. or or. need.	.....	145 d.	.....	22$^{21°}$	1 c.; v. s. h.	v. sl. s.
22	colorl. tricl.	.....	235 d.	.....	sl. s. c.; v. s. h.	v. sl. s. h.	i.
23	colorl. monocl.	.....	270–6 d.	.....	v. s.	s.	.....
24	wh. powd.	.....	95	.....	.....	s.	.....
25	need.	.....	251–2	subl.	.....	1 : 118 c.; 1 : 23.4 h.	1 : 250.5 c.; 1 : 32.5 h.
26	wh. powd.	.....	195	.....	sl. s.	v. s.	.....
27	br. powd.	.....	.....	.....	sl. s.	.....	sl. s.
28	dk. red rhombs.	.....	192–2.5	.....	v. sl. s.; s. alk.	sl. s.	v. sl. s.
29	blk. powd.	.....	.....	.....	i.	s.	sl. s.
30	liq.	.....	.....	.....	i.	s.	s.
31	colorl. need.	.....	190 d.	.....	1.54$^{16°}$ 45.5$^{10°}$	v. s.	v. sl. s.
32	colorl. hex. leaf.	.011	210.5	subl.	v. sl. s.	v. s.	v. s.
33	colorl. hex. leaf.	1.011	203.4	212–2	v. sl. s.	v. s.	v. s.
34	colorl.	.....	29	223	v. sl. s.	v. s.	s.
35	.....	.....	158–60	200	sl. s.	v. s.	v. s.

No.	Name	Synonyms	Formula	Mol. wt.
1	Bornylchloride		$C_{10}H_{17}Cl$	172.59
2	Borontriethyl		$B(C_2H_5)_3$	97.94
3	Brassidic acid		$C_{22}H_{42}O_2$	338.34
4	Brazilein		$C_{16}H_{12}O_5$	284.10
5	Brazilin		$C_{16}H_{14}O_5 + 1\frac{1}{2}H_2O$	313.14
6	Brom-acetic acid		$CH_2BrCOOH$	138.94
7	acetone		$CH_2Br \cdot CO \cdot CH_3$	136.96
8	acetylene		C_2HBr	104.92
9	allyl alcohol		$CH_2 : CBr \cdot CH_2OH$	136.96
10	aniline (o.)		$Br \cdot C_6H_4NH_2$	171.97
11	" (m.)		$Br \cdot C_6H_4NH_2$	171.97
12	" (p.)		$Br \cdot C_6H_4NH_2$	171.97
13	anthraquinone (o.)		$C_6H_4(CO)_2C_6H_3Br$	286.97
14	anthraquinone (m.)		$C_6H_4(CO)_2C_6H_3Br$	286.97
15	benzene	phenyl bromide	C_6H_5Br	
16	benzoic acid (o.)		$BrC_6H_4 \cdot COOH$	200.96
17	" " (m.)		$BrC_6H_4 \cdot COOH$	200.96
18	" " (p.)		$BrC_6H_4 \cdot COOH$	200.96
19	camphor		$C_{10}H_{15}BrO$	231.04
20	cinnamic acid (α)		$C_6H_5 \cdot CH : CBr \cdot COOH$	226.97
21	" " (β)		$C_6H_5 \cdot CBr : CH \cdot COOH$	226.97
22	ethylene		$CH_2 : CHBr$	106.94
23	hexahydro-benzene		$C_6H_5Br_7H_6$	163.00
24				
25	naphthalene (α)		$C_{10}H_7Br$	206.97
26	" (β)		$C_{10}H_7Br$	206.97
27	nitrobenzene (o.)		$BrC_6H_4NO_2$	201.96
28	" (m.)		$BrC_6H_4NO_2$	201.96
29	" (p.)		$BrC_6H_4NO_2$	201.96
30	phenol (o.)		BrC_6H_4OH	172.96
31	" (m.)		BrC_6H_4OH	172.96
32	" (p.)		BrC_6H_4OH	172.96
33	phthalic acid (v.)		$C_6H_3Br(COOH)_2$	244.96
34	styrene (α)		$C_6H_5 \cdot CH : CHBr$	182.97
35	" (β)		$C_6H_5 \cdot CBr : CH_2$	182.97
36	toluene (o.)		$BrC_6H_4CH_3$	170.97
37	" (m.)		$BrC_6H_4CH_3$	170.97
38	" (p.)		$BrC_6H_4CH_3$	170.97
39	Bromal	tribromaldehyde	$CBr_3 \cdot CHO$	280.76
40	Bromoform		$CHBr_3$	252.76
41	Brucine		$C_{23}H_{26}O_4N_2 + 4H_2O$	466.29
42	hydrochloride		$C_{23}H_{26}O_4N_2 \cdot HCl$	430.69
43	nitrate		$C_{23}H_{26}O_4N_2 \cdot HNO_3 + 2H_2O$	493.27

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form and color	Sp. gr. $H_2O = 1$ (A)Air = 1	Melting-point °C	Boiling-point °C	Solubility in gms. per 100 c.c. of		
					Water	Alcohol	Ether
1	.....	.....	148	.....	d. 40°	v. s.	v. s.
2	liq.	$0.691^{23°}$	.....	95	.....	s.	s.
3	colorl. lvs.	$0.859^{57°}$	60	.....	$0.74^{24°}$	v. sl. s. c.	s.
4	rhomb. leaf.	.....	.....	.....	.....	s.	s. alk.
5	colorl. need.	.....	abt. 250	.....	sl. s.	s.	s.
6	colorl. hex.	.....	50	208	∞	∞	∞
7	.....	.....	.....	136.5 725mm.	.....	.....	.....
8	gas.....	.....	.....	−2	v. s.	s.	.....
9	.....	$1.6^{18°}$	.....	155	.....	.....	.....
10	.....	.....	31–1.5	250–1	.....	s.	.....
11	.....	$1.582^{21°}$	18–18.5	251	.....	s.	.....
12	rhombs.	.....	66.4	d.	i.	v. s.	v. s.
13	yel. need. f. bz.	.....	188	subl.	.....	s.	.....
14	yel. need.	.....	187	subl.	s. h. bz.	sl. s.	.....
15	.....	$1.4991^{18°}_{18°}$	−30.5	156.6	.....	s.	s.
16	colorl. need.	.....	150	subl.	$0.18^{25°}$	v. s.	v. s.
17	colorl. need.	.....	155	.....	$0.04^{25°}$	v. s.	v. s.
18	colorl. monocl.	.....	251	.....	v. sl. s. c.	s.	v. s.
19	monocl. pr. f. al.	1.437	76	274	s. bz.	sl. s.	s. CS_2
20	need. f. w.	.....	130–1	.....	.....	∞	∞
21	hex. cryst.	.....	120	.....	s. h.	v. s.	v. s. CS_2
22	.....	$1.517^{14°}$	.....	$16^{750mm.}$	i.	∞	∞
23	.....	.....	.....	162	.....	.....	.....
24							
25	pr.	$1.487^{20°}_{4°}$	5	279	α bz.	α abs.	∞
26	rhomb. lvs.	$1.605^{0°}$	59	282	s. bz.	6	v. s.
27	.....	.....	38.5	264.4	i.	v. s.	s.
28	.....	.....	52.6	257.5	i.	s.	s.
29	monocl.	$1.934^{22°}$	125	259.2	i.	s.	.....
30	oil	.....	5.6	195	s. alk.	.....	.....
31	leaf.	.....	32–3	236	s. alk.	.....	.....
32	tetr.	1.840	63–4	238	s. chl.	v. s.	v. s.
33	powd.	.....	138–40	.....	v. s.	v. s.	v. s.
34	.....	.....	.....	d.	.....	.....	.....
35	.....	.....	7	219–21	.....	.....	.....
36	liq.	$1.431^{18°}_{18°}$	−26	181	i.	s.	.....
37	liq.	$1.410^{20°}$	−40	183	i.	s.	.....
38	rhomb.	$1.354^{64°}$	28.5	184–5	i.	s.	s.
39	yel. liq.	2.65	.....	174	dec.	.....	.....
40	colorl. liq.	$2.884^{25°}$	9	151.2	sl. s.	∞	∞
41	monocl.	.....	105	.....	0.31 c.; $0.67^{100°}$	v. s.	v. sl. s.
42	need.	.....	.....	.....	v. s.	.....	.....
43	prisms	.....	230 d.	.....	s.	s.	.....

No.	Name	Synonyms	Formula	Mol. wt.
1	Brucine sulfate		$(C_{23}H_{26}O_4N_2)_2H_2SO_4 + 7H_2O$	1012.64
2	Butane (n.)		$CH_3 \cdot CH_2 \cdot CH_2 \cdot CH_3$	58.08
3	Butyl acetate		$CH_3 \cdot COO \cdot C_4H_9$	116.10
4	alcohol (n.)		$CH_3 \cdot (CH_2)_2 \cdot CH_2OH$	74.08
5	" (sec.)	methyl ethyl carbinol	$CH_3 \cdot CH_2 \cdot CHOH \cdot CH_3$	74.08
6	" (iso)		$(CH_3)_2 \cdot CH \cdot CH_2OH$	74.08
7	" (tert.)	trimethyl carbinol	$(CH_3)_3 \cdot COH$	74.08
8	amine (n.)		$CH_3 \cdot (CH_2)_2 \cdot CH_2 NH_2$	73.10
9	" (sec.)		$CH_3 \cdot CH(NH_2) \cdot CH_2 \cdot CH_3$	73.10
10	benzene (n.)		$C_6H_5 \cdot C_4H_9$	134.11
11	" (iso.)		$C_6H_5 \cdot C_4H_9$	134.11
12	" (sec.)		$C_6H_5 \cdot C_4H_9$	134.11
13	benzoate (n.)		$C_6H_5 \cdot COO \cdot C_4H_9$	178.11
14	bromide (n.)		$CH_3 \cdot (CH_2)_2 \cdot CH_2Br$	136.99
15	butyrate (n.)		$C_3H_7 \cdot COO \cdot C_4H_9$	144.13
16	carbinol		$(CH_3)_3 \cdot C \cdot CH_2OH$	88.10
17	chloral		$C_4H_5Cl_3O$	175.51
18	" hydrate		$C_4H_5Cl_3O + H_2O$	193.53
19	chloride (n.)		$CH_3 \cdot (CH_2)_2CH_2Cl$	92.53
20	" (tert.)		$(CH_3)_3C \cdot Cl$	92.53
21	cyanide (n.)	valeronitrile	$CH_3 \cdot (CH_2)_2CH_2CN$	83.08
22	" (tert.)		$(CH_3)_3C \cdot CN$	83.08
23	ether (n.)		$(C_4H_9)_2O$	130.14
24	formate		$HCOO \cdot C_4H_9$	102.08
25	iodide (n.)		$CH_3(CH_2)_2CH_2I$	184.00
26	" (sec.)		$CH_3 \cdot CH_2 \cdot CHI \cdot CH_3$	184.00
27	" (tert.)		$(CH_3)_3C \cdot I$	184.00
28	mustard oil (n.)		$CH_3 \cdot (CH_2)_2CH_2NCS$	115.14
29	" " (sec.)		$CH_3 \cdot CH_2 \cdot CH(NCS) CH_3$	115.14
30	" " (tert.)		$(CH_3)_3C \cdot NCS$	115.14
31	phenyl ketone		$C_4H_9 \cdot CO \cdot C_6H_5$	162.11
32	sulfide (n.)		$[CH_3 \cdot (CH_2)_2CH_2]_2 : S$	146.21
33	" (sec.)		$(CH_3 \cdot CH_2 \cdot CH \cdot CH_3)_2S$	146.21
34	Butylene (n.)	ethyl ethylene	$C_2H_5 \cdot CH : CH_2$	56.06
35	glycol (α)		$CH_3 \cdot CH_2 \cdot CH(OH) \cdot CH_2OH$	90.08
36	" (β)		$CH_3 \cdot CH(OH) \cdot CH_2 \cdot CH_2OH$	90.08
37	" (pseudo)		$CH_3 \cdot CH(OH) \cdot CH(OH)CH_3$	90.08
38	Butyramide (n.)		$CH_3 \cdot CH_2 \cdot CH_2 \cdot CONH_2$	87.08
39	Butyric acid (n.)		$CH_3 \cdot (CH_2)_2 \cdot COOH$	88.06
40	aldehyde (n.)		$CH_3 \cdot (CH_2)_2 \cdot CHO$	72.06
41	anhydride		$[CH_3 \cdot (CH_2)_2CO]_2 \cdot O$	158.11
42	Butyryl chloride (n.)		$CH^2 \cdot CH_2 \cdot CH_2 \cdot COCl$	106.51
43	Butyryl chloride (iso.)		$(CH_3)_2 \cdot CH \cdot COCl$	106.51

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form and color	Sp. gr. $H_2O = 1$ (A)Air = 1	Melting-point °C	Boiling-point °C	Solubility in gms. per 100 c.c. of		
					Water	Alcohol	Ether
1	long need.	.....	.....	.....	s.	s.	.....
2	gas	0.60$^{0°}$ 2.046 (A)	.....	1	i.	5.6 c.	.....
3	colorl. liq.	0.882$^{20°}$	.....	125	sl. s.	∞	∞
4	colorl. liq.	0.810$^{20°}$	.....	117	8.3	∞	∞
5	colorl. liq.	0.819$^{22°}$	.....	99.8	29$^{20°}$	.....	.....
6	colorl. liq.	0.806$^{15°}$	−108	106.5	9.5$^{18°}$	∞	∞
7	colorl. liq. or rhomb.	0.781$^{25°}$	25	82.9	∞	s.	∞
8	colori. liq.	0.740$^{20°}$	.....	78	v. s.	s.	s.
9	liq.	0.7557$^{15°}$	.....	65.5	∞	.....	.....
0	.....	0.875$^{0°}$	.....	180	.....	.....	.....
1	.....	0.89$^{15°}$	.....	167.5	.....	.....	.....
2	.....	0.8726$^{16°}$	.....	170–2	.....	.....	.....
3	oil	1.000$^{20°}$	.....	247.3–9.0	i.	∞	∞
4	liq.	1.279$^{20°}$	.....	101	i.	∞	∞
5	colorl. liq.	0.888$^{0°}$	.....	165	sl. s.	∞	∞
6	.....	0.812$^{20°}$	52–3	113–4	sl. s.	v. s.	v. s.
7	liq.	1.395$^{20°}$	.....	164	d.	.....	.....
8	leaf. f. w.	1.693	78	d.	.....	.....	.....
9	colorl. liq.	0.887$^{20°}$	.....	77.5–8.0	i.	∞	∞
0	liq.	0.8658$^{0°}$	.....	50–1	.....	.....	.....
1	liq.	1.000$^{20°}$	.....	141	i.	s.	s.
2	cryst.	.....	15–6	105–6	.....	.....	.....
3	colorl. liq.	0.769$^{40°}$	.....	141	s.	.....	.....
4	colorl. liq.	0.911$^{0°}$	.....	106.9	sl. s.	∞	∞
5	liq.	1.617$^{20°}$	.....	129.6	i.	∞	∞
6	liq.	1.62	.....	117–18	.....	.....	.....
7	liq.	1.571$^{0°}$	.....	98–9 d.	.....	.....	.....
8	liq.	.....	.....	167	i.	v. s.	v. s.
9	liq.	0.944$^{12°}$	.....	159.5	.....	.....	.....
0	.....	0.9487$^{10°}$	10.5	140	.....	.....	.....
1	liq.	.....	.....	237.5–8.5	i.	v. s.	v. s.
2	liq.	0.8523$^{0°}$	.....	182	i.	.....	.....
3	liq.	0.8317$^{23°}$	.....	165	.....	.....	.....
4	gas	.....	1.5–2.5	.....	i.	v. s.	v. s.
5	liq.	1.019$^{0°}$	.....	191–2	sl. s.	∞	.....
6	liq.	1.0259	.....	203.5–4.0	sl. s.	s.	i.
7	liq.	1.048$^{0°}$	.....	183–4	∞	s.	s.
8	wh. tab.	.....	115–6	216	s.	s.	sl. s.
9	colorl. liq.	0.960$^{19°}$	−7.9	162.5	∞	∞	∞
0	colorl. liq.	0.817$^{20°}$	.....	73–4	3.7	∞	∞
1	colorl. liq.	0.978	.....	191–3	dec.	dec.	∞
2	liq.	1.0277$^{20°}_{4°}$	.....	100–1.5	.....	.....	.....
3	liq.	.....	.....	92	.....	.....	.....

No.	Name	Synonyms	Formula	Mol. wt.
1	Butyrine	tributyrine	$(C_3H_7\cdot COO)_3C_3H_5$	302.21
2	Cacodyl		$(CH_3)_2As\cdot As(CH_3)_2$	210.02
3	chloride		$(CH_3)_2AsCl$	140.46
4	oxide		$(CH_3)_2As)_2\cdot O$	226.02
5	sulfide		$[(CH_3)_2As]_2S$	242.08
6	trichloride		$(CH_3)_2AsCl_3$	211.38
7	Cacodylic acid		$(CH_3)_2AsO\cdot OH$	138.02
8	Caffeic acid		$C_9H_8O_4 + \frac{1}{2}H_2O$	189.07
9	Caffeine	theine, 1, 3, 7-trimethyl-xanthine	$C_8H_{10}O_2N_4 + H_2O$	212.13
10	Camphane		$C_{10}H_{18}$	138.14
11	Camphene (i.)		$C_{10}H_{16}$	136.13
12	" (d. or l.)		$C_{10}H_{16}$	136.13
13	Campholic acid		$C_{10}H_{18}O_2$	170.14
14	Camphor (d.)		$C_{10}H_{16}O$	152.13
15	Camphoric acid (i.)		$C_8H_{14}(COOH)_2$	200.13
16	" " (d.)		$C_8H_{14}(COOH)_2$	200.13
17	" anhydride		$C_{10}H_{14}O_3$	182.11
18	Camphoronic acid		$C_6H_{11}(COOH)_3$	218.11
19	Camphylamine		$C_9H_{15}(CH_2\cdot NH_2)$	153.16
20	Cane sugar.	See *sucrose*		
21	Cantharidine		$C_{10}H_{12}O_4$	196.10
22	Capric acid		$CH_3\cdot(CH_2)_8\cdot COOH$	172.16
23	Caproic acid (n.)		$CH_3\cdot(CH_2)_4\cdot COOH$	116.10
24	Caprylic acid		$C_7H_3\cdot(CH_2)_6\cdot COOH$	144.13
25	Carbamide chloride		$CO\cdot(NH_2)\cdot Cl$	79.48
26	Carbanil	phenyl isocyanate	$C_6H_5\cdot NCO$	119.05
27	Carbanilid	diphenyl urea	$C_6H_5\cdot NH\cdot CO\cdot NH\cdot C_6H_5$	212.11
28	Carbazide	carbohydrazide	$CO(NH\cdot NH_2)_2$	90.08
29	Carbazole		$C_6H_4\cdot NH\cdot C_6H_4$	167.08
30	Carbodiphenylimide		$C(NC_6H_5)_2$	194.10
31	Carbolic acid.	See *phenol*		
32	Carbon dioxide		CO_2	44.00
33	disulfide		CS_2	76.13
34	hexachloride		C_2Cl_6	236.74
35	monoxide		CO	28.00
36	oxysulfide		COS	60.06
37	suboxide		C_3O_2	68.00
38	tetrabromide		CBr_4	331.66
39	tetrachloride	tetrachlormethane	CCl_4	153.83
40	tetraiodide		CI_4	519.73
41	Carbonyl chloride	phosgene	$COCl_2$	98.91
42	disulfethyl		$CO(SC_2H_5)_2$	150.21
43	sulfide	carbon oxysulfide	COS	60.06
44	Carbo-styril	2-hydroxy-quinoline	$HO\cdot C_9H_6N(Py2)$	145.06
45	thialdine		$NH_2CS\cdot S\cdot N(C_2H_4)_2$	162.22

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form and color	Sp. gr. H_2O = 1 (A)Air = 1	Melting-point °C	Boiling-point °C	Solubility in gms. per 100 c.c. of		
					Water	Alcohol	Ether
1	.....	1.052	.....	285	i.	v. s.	v. s.
2	colorl. liq.	.....	−6	170	sl. s.	s.	s.
3	.....	.....	.....	100	i.	.....	.....
4	.....	1.462	−25	120	i.	.....	.....
5	.....	.....	40 d.	>100	s.	s.	.....
6	.....	.....	.....	.....	d.	.....	.....
7	rhomb.	.....	200 d.	.....	v. s.	v. s.	v. sl. s.
8	yel. pr.	.....	195	d.	s.	v. s.	.....
9	wh. need.	$1.23^{19°}$	229.5–30.5	.....	$1.35^{18°}$; $45.5^{55°}$	$2.3^{16°}$ (85%)	$0.044^{16°}$
10	cryst.	.....	154	160	.....	.....	.....
11	feath. need.	.....	47	157	i.	v. s.	v. s.
12	feath. need. f. al.	.....	51–2	159	i.	v. s.	v. s.
13	tricl. pr.	.....	95 (106)	250	sl. s. c.	s.	s.
14	colorl. hex.	$0.992^{100°}$	176.4	205.3	v. sl. s.	$120^{12°}$	v. s.
15	.....	1.228	208	.....	$0.76^{25°}$; $10^{100°}$	s.	v. s.
16	colorl. monocl.	1.186	187	.....	$0.62^{12°}$; $8.3^{100°}$	112	.....
17	rhomb. f. al.	.....	220–1	abt. 270 d.	v. sl. s.	v. s.	v. s.
18	sm. need.	.....	136–7	.....	6	v. s.	v. s.
19	leaf.	$0.93^{37°}$	.....	194–6	.....	.....	.....
20							
21	rhomb. pl.	.....	218	.....	i.	$0.03^{18°}$	0.11
22	colorl. need.	$0.930^{37°}$	31.3	268.4	v. sl. s.	s.	s.
23	colorl. liq.	$0.929^{20°}$	−5.2	205.7	v. sl. s.	s.	s.
24	colorl. lvs.	$0.910^{20°}$	16.5	237.5	$0.25^{100°}$	∞	∞
25	need.	.....	50	61	i.	i.	.....
26	liq.	$1.092^{15°}$	.....	163	d.	interacts	.....
27	need. fr. al.	.....	236–7	.....	v. sl. s.	v. s.	v. s.
28	.....	.....	152	.....	.....	.....	.....
29	colorl. lvs.	.....	238.5	354.7	i.	$0.92^{1.4°}$	sl. s.
30	amor.	.....	.....	330	.....	d. h.	d. HCl.
31							
32	gas	1.53 (A)	−65	−80	$179.7^{0°}$; $107.5^{15°}$ c.c.	$319.9^{15°}$ c.c.	.....
33	colorl. liq.	$1.256^{22°}$	−112.8	46.2	$0.22^{22°}$	∞	∞
34	rhombic.	$1.99^{20°}$	182	187	i.	s.	v. s.
35	gas	0.967(A)	−205.7–7.0	−190	$2.5^{15°}$ c.c.	$20^{20°}$ c.c.	.....
36	gas	2.104(A)	.....	−47.5	100c.c.	.....	.....
37	gas	$1.11^{0°}$	−107	7	dec.	.....	s.
38	tab.	3.42	92	189	i.	s.	s.
39	colorl. liq.	$1.584^{25°}$	−23	76	$0.08^{20°}$	∞	∞
40	red	$4.32^{20°}$	.....	dec.	i.	s.	s.
41	gas	.....	<−75	8.2	dec.	dec.	.....
42	.....	$1.085^{19°}$	.....	196.7	.....	.....	.....
43	gas	.....	.....	.....	s.	.....	.....
44	pr. fr. al.	.....	199–200	subl.	v. sl. s.; s. h.	v. s.	v. s.
45	.....	.....	.....	.....	i.	sl. s.	i.; s. s.

No.	Name	Synonyms	Formula	Mol. wt.
1	Carbyl-oxime.	See *fulminic acid*		
2	sulfate.		$CH_2O \cdot SO_2 \cdot O \cdot SO_2 \cdot CH_2$	188.16
3	Carmine red.		$C_{11}H_{12}O_7$	256.10
4	Carminic acid.		$C_{22}H_{22}O_{13}$	494.18
5	Carnine.		$C_7H_8N_4O + H_2O$	182.11
6	Carvacrol.	isopropylhydroxy-toluene	$(CH_3)_2CH \cdot C_6H_3 \cdot (CH_3) \cdot OH(4, 1, 2)$	150.11
7	Carvenone.	carveol.	$C_{10}H_{16}O$	152.13
8	Carvomenthene.		$C_{10}H_{18}$	138.14
9	Carvomenthol.		$C_{10}H_{19}OH$	156.16
10	Carvon.	anise oil.	$C_{10}H_{14}O$	150.11
11	Caryophylin.		$C_{20}H_{32}O_2$	304.26
12	Catechin.		$C_{19}H_{18}O_8$	342.14
13	Catechol.	pyrocatechin.	$C_6H_4(OH)_2(o.)$	110.05
14	Cedrene.		$C_{15}H_{24}$	204.19
15	Cedriret.	cörulignon.	$C_{16}H_{16}O_6$	304.13
16	Cellulose.		$(C_6H_{10}O_5)x$	(162.08)x
17	acetate penta-.		$C_6H_5(COOCH_3)_5$	372.16
18	" tetra-.		$C_6H_6O(COOCH_3)_4$	330.14
19	" tri-.		$C_6H_7O_2(COOCH_3)_3$	288.13
20	nitrate hexa-.	principal constituent of gun cotton	$C_{12}H_{14}O_4(NO_3)_6$	594.16
21	" penta-.		$C_{12}H_{15}O_5(NO_3)_5$	549.16
22	" tetra-.	constituents of collodion	$C_{12}H_{16}O_6(NO_3)_4$	504.16
23	" tri-.	constituents of collodion	$C_{12}H_{17}O_7(NO_3)_3$	459.16
24	Cerotic acid.		$C_{26}H_{52}O_2$	396.42
25	Ceryl alcohol.		$C_{26}H_{54}O$*	382.43
26	Cetyl alcohol.	ethal.	$C_{16}H_{33}OH$	242.27
27	Cetylene.		$C_{16}H_{30}$	222.24
28	Chlor-acetanilide (o.)		$Cl \cdot C_6H_4 \cdot NH \cdot C_2H_3O$	169.53
29	Chlor-acetanilide (m.)		$Cl \cdot C_6H_4 \cdot NH \cdot C_2H_3O$	169.53
30	Chlor-acetanilide (p.)		$Cl \cdot C_6H_4 \cdot NH \cdot C_2H_3O$	169.53
31	acetic acid.		$CH_2Cl \cdot COOH$	94.48
32	acetone.		$CH_2Cl \cdot CO \cdot CH_3$	92.50
33	acetyl chloride.		$CH_2Cl \cdot COCl$	112.93

*Also given as $C_{27}H_{56}O$

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form and color	Sp. gr. H_2O = 1 (A)Air = 1	Melting-point °C	Boiling-point °C	Solubility in gms. per 100 c.c. of		
					Water	Alcohol	Ether
1							
2	cryst.	.....	80	.....	deliq. d.	.....	.....
3	red or.	.....	.....	.....	s.	s.	i.
4	monocl. pr.	.....	136 d.	.....	v. s.	s.	v. sl. s.
5	sm. cryst.	.....	.....	.....	s. h.	i.	i.
6	oil	$0.978^{20°}_{20°}$	.....	236–8	s. al.	.....	s.
7	.....	0.927	.....	232	.....	.....	.....
8	.....	.....	.....	175	.....	.....	.....
9	.....	$0.904^{20°}$	.....	221–2	.....	.....	.....
10	.....	$0.9608^{20°}_{4°}$	.....	230; $104^{11\,mm.}$	v. sl. s.	∞	∞
11	cryst.	.....	.....	280 subl.	i.	sl. s.	v. s.
12	.....	.....	217	d.	i.	s.	s.
13	colorl. lvs. f. bz.	1.344	104	240–45	v. s.	v. s.	v.
14	liq.	.....	.....	237	.....	.....	.....
15	blue need.	.....	d.	.....	s. h.	i.	s. H_2SO_4
16	amor.	abt. 1.5	.....	.....	i.*	i.	i.
17	amor.	.....	.....	.....	i.	s.	.....
18	amor.	.....	soft. abt. 150	.....	i.; i. acet.	i.; i. meth.	i.; i. amyl.‡ acet.
19	amor.	.....	.....	.....	i.	i.; i. acet.	i.‡
20	wh. amor.	abt. 1.66	ign. 160 –70	.....	i.; i. bz.	i.; v. v. sl. s. eth.-al.	i.; s.† nitro-bz.
21	wh. amor.	abt. 1.66	.....	.....	i.; i. bz.	i.; s. eth.-al.	i
22	wh. amor.	abt. 1.66	.....	.....	i.; i. bz.	i.; s. eth.-al.	i.; s. meth. al.
23	wh. amor.	abt. 1.66	.....	.....	i.; i. bz.	s. abs.; s. meth.	s. glac. acet. a.h.
24	need. f. al.	$0.836^{79°}$	78–82.5	dec.	i.; s. acet.	v. sl. s.c.; s. h.	$20^{25°}$ s. bz.
25	colorl. cryst.	.....	79	.....	i.	s.	s.
26	leaf. f. al.	$0.818^{50°}$	50	344	i.	s.	s.
27	.....	.....	–25	280–5	.....	.....	.....
28	need.	.....	87–8	.....	.....	s.	s. bz.
29	need.	.....	72.5	.....	.....	s.	s. bz.
30	need.	.....	172.5	.....	.....	s.	s.
31	colorl. rhomb.	$1.398^{51°}$	62–3	186	v. s.	s.	s.
32	colorl. liq.	$1.162^{16°}$	.....	119	sl.	∞	∞
33	colorl. liq.	$1.495^{0°}$	.....	105–6	d.	d.	.....

* Soluble in conc. H_2SO_4 and ammoniacal CuO.
† All nitro celluloses are soluble in acetone, ethyl acetate, amylacetate.
‡ Soluble in chl., glac. acet. a. and nitrobenzene.

No.	Name	Synonyms	Formula	Mol. wt.
1	Chloracetylene		C_2HCl	60.46
2	acrylic acid (α)		$CH_2:CCl\cdot COOH$	106.48
3	" " (β)		$CHCl:CH\cdot COOH$	106.48
4	aniline (o.)		$ClC_6H_4\cdot NH_2$	127.51
5	" (m.)		$ClC_6H_4\cdot NH_2$	127.51
6	" (p.)		$ClC_6H_4\cdot NH_2$	127.51
7	benzamide (o.)		$ClC_6H_4\cdot CONH_2$	155.51
8	" (m.)		$ClC_6H_4\cdot CONH_2$	155.51
9	" (p.)		$ClC_6H_4\cdot CONH_2$	155.51
10	benzene	phenylchloride	C_6H_5Cl	112.50
11	benzoic acid (o.)		ClC_6H_4COOH	156.50
12	" " (m.)		ClC_6H_4COOH	156.50
13	" " (p.)		ClC_6H_4COOH	156.50
14	benzyl chloride (p.)		$Cl\cdot C_6H_4\cdot CH_2Cl$	160.96
15	camphor		$C_{10}H_{16}Cl_2$	207.04
16	crotonic acid (α)		$CH_3\cdot CH:CCl\cdot COOH$	120.50
17	diphenyl (o.)		$Cl\cdot C_6H_4\cdot C_6H_5$	188.53
18	" (m.)		$Cl\cdot C_6H_4\cdot C_6H_5$	188.53
19	" (p.)		$Cl\cdot C_6H_4\cdot C_6H_5$	188.53
20	ethyl alcohol (2)		$CH_2Cl\cdot CH_2OH$	80.50
21	malonic acid		$CHCl\cdot(COOH)_2$	138.48
22	naphthalene (α)		$C_{10}H_7Cl$	162.51
23	" (β)		$C_{10}H_7Cl$	162.51
24	nitro-benzene (o.)		$ClC_6H_4\cdot NO_2$	157.50
25	" " (m.)		$ClC_6H_4\cdot NO_2$	157.50
26	" " (p.)		$ClC_6H_4\cdot NO_2$	157.50
27	nitronaphthalene (α_1, α_2)		$C_{10}H_6Cl(NO_2)$	207.51
28	nitronaphthalene (β_1, α_4)		$C_{10}H_6Cl(NO_2)$	207.51
29	phenol (o.)		$Cl\cdot C_6H_4\cdot OH$	128.50
30	" (m.)		$Cl\cdot C_6H_4\cdot OH$	128.50
31	" (p.)		$Cl\cdot C_6H_4\cdot OH$	128.50
32	phthalic acid (1, 2, 4)		$Cl\cdot C_6H_3(COOH)_2$	200.50
33	picrin	nitro-chloroform, nitrotrichlormethane	CCl_3NO_2	164.38
34	propionic acid (α)		$CH_3\cdot CHCl\cdot COOH$	108.50
35	" " (β)		$CH_2Cl\cdot CH_2\cdot COOH$	108.50
36	pyridine (2)		ClC_5H_4N	113.50
37	" (3)		ClC_5H_4N	113.50
38	" (4)		ClC_5H_4N	113.50
39	quinoline (2)		ClC_9H_6N	163.51
40	" (3)		ClC_9H_6N	163.51
41	" (4)		ClC_9H_6N	163.51
42	toluene (o.)		$ClC_6H_4\cdot CH_3$	126.51
43	" (m.)		$ClC_6H_4\cdot CH_3$	126.51
44	" (p.)		$ClC_6H_4\cdot CH_3$	126.51

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form and color	Sp. gr. $H_2O = 1$ (A)Air = 1	Melting-point °C	Boiling-point °C	Solubility in gms. per 100 c.c. of		
					Water	Alcohol	Ether
1	gas	.....	spon.	infl.	.....	.....	.....
2	.....	.....	.....	176–81 d.	∞	∞	∞
3	lvs.	.....	84–5	.....	.....	.....	.....
4	liq.	$1.213^{20°}$	.....	207	s. a.	.....	s.
5	liq.	$1.216^{20°}$	.....	230	s. a.	.....	.....
6	rhomb.	$1.340^{18°}$	70	230–2	s. h.; s. a.	s.	s.
7	long. need.	.....	142.4	.....	sl. s.	v. s.	v. s.
8	need.	.....	134.5	.....	sl. s.	v. s.	.....
9	need.	.....	178.3	.....	v. sl. s.	v. s.	v. s.
10	colorl. liq.	$1.106^{20°}$	–45	132	i.	∞	∞
11	colorl. rhomb.	1.540	137, (142)	.....	$0.21^{25°}$	v. s.	v. s.
12	colorl. prisms	.....	153, (158)	subl.	$0.04^{0°}$	s.	s.
13	colorl. monocl.	$1.541^{24°}$	236 (240–3)	.....	v. sl. s.	v. s.	v. s.
14	.....	.....	29	213–4	.....	s. c.; v. s. h.	v. s.
15	need. f. al.	.....	155–5.5	.....	.....	s.	v. s.
16	long. need.	.....	97.5	212	.....	.....	.....
17	monocl.	.....	34	267–8	.....	s. lgr.	.....
18	.....	.....	89	.....	.....	.....	.....
19	pr. or sm. need.	.....	75–6	282	.....	.....	.....
20	colorl. liq.	$1.213\frac{15°}{4°}$	69	128*	∞	∞	∞
21	prisms	.....	133	.....	v. s.	v. s.	v. s.
22	colorl.	$1.194^{20°}$	.....	263	i.	s.	s.
23	colorl. leaf.	$1.266^{18°}$	56	265	i.	s.	s.
24	need.	$1.368^{22°}$	32.5	246	i.	s.	s.
25	rhomb.	1.534	44.2	235.6	s. bz.	v. s. h.	s.
26	monocl.	$1.520^{18°}$	83	239–42	i.	s.	.....
27	yel. need.	.....	85	.....	i.	s.	s.
28	yel. need.	.....	116	.....	i.	s.	.....
29	colorl. liq.	$1.241\frac{18°}{18°}$	8.8	175–6	.....	s.	.....
30	colorl. liq.	$1.245^{18°}$	32.8	214	.....	s.	.....
31	colorl. liq.	$1.306^{20°}$	42.9	217	v. sl. s.	v. s.	v. s.
32	.....	.....	.....	.....	s.	s.	.....
33	liq.	$1.692^{0°}$	–69.2	112	i.	∞	∞
34	colorl. liq.	$1.28^{0°}$	.....	186	∞	∞	∞
35	colorl. leaf.	.....	41.5	203–5	v. s.	v. s.	∞
36	liq.	1.205	.....	166^{714mm}	v. sl. s.	.....	.....
37	liq.	.....	.....	148^{743mm}	.....	.....	.....
38	liq.	.....	.....	147–8	s.	.....	.....
39	need.	$1.275^{17°}$	37–8	275	v. sl. s.	v. s.	v. s.
40	.....	.....	.....	255^{743mm}	.....	.....	.....
41	.....	$1.377^{17°}$	34	260–1 ^{744mm}	.....	v. s.	v. s.
42	colorl. liq.	$1.085^{18°}$	–34	157	sl. s.	s.	∞
43	colorl. liq.	$1.072^{20°}$	–47.8	162 (150)	sl. s.	s.	∞
44	colorl. liq.	$1.071^{8°}$	6.5–7.5	162	sl. s.	s.	∞

* Constant boiling mixture, 42.5% H_2O — boiling point 95.8°.

No.	Name	Synonyms	Formula	Mol. wt.
1	Chloral	trichloracetic aldehyde	$CCl_3 \cdot CHO$	147.38
2	alcoholate		$CCl_3 \cdot CH(OH) \cdot O \cdot C_2H_5$	193.43
3	hydrate		$CCl_3 \cdot CH(OH)_2$	165.40
4	Chloranil		$C_6Cl_4O_2$	245.83
5	Chlorhydrine (α)		$CH_2Cl \cdot CHOH \cdot CH_2OH$	110.51
6	Chloroform	trichlormethane	$CHCl_3$	119.38
7	Cholesterol	cholesterin	$C_{26}H_{43}OH + H_2O$	390.37
8	benzoate		$C_{26}H_{43}OC_7H_5O$	476.38
9	Cholic acid		$C_{24}H_{40}O_5 + H_2O$	426.34
10	Choline	bilineurine	$HO \cdot CH_2 \cdot CH_2 \cdot N(CH_3)_3OH$	121.13
11	Chromone	benzo-γ-pyrone	$C_6H_4 \cdot CO \cdot CH : CHO$	146.05
12	Chrysammic acid		$C_{14}H_2(NO_2)_4(OH)_2O_2$	420.06
13	Chrysaniline		$C_{19}H_{15}N_3 + 2H_2O$	321.18
14	Chrysarobine	dyhydroxy-methyl-anthranol	$C_{15}H_{12}O_2$	224.10
15	Chrysazine		$C_6H_3(CO)_2C_6H_3OH$	224.10
16	Chrysene		$C_{18}H_{12}$	228.10
17	Chrysine		$C_{15}H_{10}O_4$	254.08
18	Chrysoïdine		$C_6H_5 \cdot N_2 \cdot C_6H_3(NH_2)_2$	212.13
19	Chrysophanic acid		$C_{14}H_5(OH)_2 \cdot CH_3O_2$	254.08
20	Chrysoquinone		$C_{18}H_{10}O_2$	258.08
21	Cincholepidine		$C_{10}H_9N$	143.08
22	Cinchomeronic acid		$C_5H_3N(COOH)_2$	167.05
23	Cinchonidine		$C_{19}H_{22}N_2O$	294.19
24	Cinchonine		$C_{19}H_{22}ON_2$	294.19
25	bisulfate		$C_{19}H_{22}ON_2 \cdot H_2SO_4 + 4H_2O$	464.34
26	hydrochloride		$C_{19}H_{22}ON_2 \cdot HCl + 2H_2O$	366.69
27	sulfate		$(C_{19}H_{22}ON_2)_2H_2SO_4 + 2H_2O$	722.49
28	Cineolic acid		$C_{10}H_{16}O_5$	216.13
29	Cinnamene	styrene	$C_6H_5 \cdot CH : CH_2$	104.06
30	Cinnamic acid	phenylacrylic acid (β)	$C_6H_5 \cdot CH : CH \cdot COOH$	148.06
31	Cinnamic anhydride		$(C_9H_7O)_2O$	278.11
32	Cinnamic aldehyde		$C_6H_5 \cdot CH : CH \cdot CHO$	132.08
33	Cinnamic carboxylic acid (o.)		$COOH \cdot C_6H_4 \cdot CH : CH \cdot COOH$	192.06

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form and color	Sp. gr. $H_2O = 1$ (A) Air = 1	Melting-point °C	Boiling-point °C	Solubility in gms. per 100 c.c. of		
					Water	Alcohol	Ether
1	colorl. liq.	$1.512^{20°}$	−57.5	98	v. s.	∞	∞
2	colorl. cryst.	$1.143^{40°}$	56	115	v. s.	s.	s.
3	colorl. tab.	1.901	57	97–97.5, d.	66	v. s.	s.
4	yel. monocl. pr. f. bz.	.....	.....	subl.	i.	s. h.	.....
5	liq.	$1.326^{18°}_{18°}$	.....	128*	s.	s.	s.
6	colorl. liq.	$1.499^{15°}$	−70	61.2	$0.62^{22°}$	∞	∞
7	monocl. tab.	1.067	148.5	.....	i.	20 h.	18
8	pl.	.....	150	.....	.....	i.	s.
9	rhomb. pl.	.....	.....	.....	v. sl. s.	s.	.....
10	visc. liq.	.....	.....	.....	s.	s.	.....
11	wh. need.	.....	59	.....	i.	s.	s.
12	monocl. yel. pr.	.....	expl.	.....	i.	s.	s.
13	yel. need.	.....	267–70	.....	v. sl. s.	sl. s.	.....
14	yel. leaf.	.....	178 ?	.....	i.	s.	s. chl.
15	red need. f. acet. a.	.....	191	.....	.....	s.	s.
16	scl. red fluor.	.....	250	448	v. sl. s.	v. s. s.	v. sl. s.
17	yel. leaf.	.....	275	subl.	i.	1 : 180 c.	sl. s.; s. alk.
18	yel. cryst.	.....	110	.....	sl. s.	s.	s.
19	yel. need.	.....	172	subl.	i.	1 : 224 b.	s.
20	or. need.	.....	235	subl.	i.	s. h.	sl. s.; s. H_2SO_4
21	liq.	.....	.....	258.8	v. sl. s.	v. s.	v. s.
22	pr. f. HCl.	.....	258 d.	.....	sl. s.	sl. s.	v. sl. s.°
23	pr.	.....	202.5	.....	v. sl. s.	$1 : 16.3^{13°}$	$1 : 188^{15}$
24	colorl. need.	.....	240–50, d.	.....	0.027^{20}	1	0.27
25	octahed.	.....	.....	.....	$217^{14°}$	$111^{14°}$	.....
26	colorl. monocl.	.....	.....	.....	4.5 c.	100	0.18
27	rhombic	.....	198.5	.....	$1.55^{13°}$	$17^{11°}$	.....
28	.....	0.92	−1	176	d.	.....	.....
29	colorl. liq.	$0.925^{0°}$	.....	146	i.	∞	∞
30	colorl. monocl.	$1.248^{4°}$	133	300	$0.1^{20°}$	$23^{20°}$	v. s.
31	cryst.	.....	127	.....	i.	sl. s.	.....
32	colorl. liq	$1.050^{24°}$	−7.5	$128–30^{20mm}$	v. sl. s	∞	∞
33	need. f. w.	.....	173–5	.....	sl. s.	v. s.	.....

*Constant boiling mixture, 42.5% H_2O — boiling point 99.8°.

PHYSICAL CONSTANTS OF

No.	Name	Synonyms	Formula	Mol. wt.
1	Cinnamone		$(C_6H_5 \cdot CH : CH)_2CO$	234.11
2	Cinnamyl alcohol		$C_6H_5 \cdot CH : CH \cdot CH_2OH$	134.08
3	Cinnamyl chloride		$C_9H_7O \cdot Cl$	166.51
4	Cinnamylmethyl-ketone		$C_6H_5 \cdot C_2H_2COCH_3$	146.08
5	Citraconic acid		$C_3H_4(COOH)_2$	130.05
6	Citral	geraniol	$C_9H_{15} \cdot CHO$	152.13
7	Citramalic acid		$C_2H_4(COOH)CHOH \cdot COOH$	148.06
8	Citrene		$C_{10}H_{16}$	136.13
9	Citric acid		$COOH \cdot CH_2 \cdot C(OH)(COOH) \cdot CH_2 \cdot COOH$	192.06
10	Citronellal		$C_9H_{17} \cdot CHO$	154.14
11	Citronellol (d.)		$C_{10}H_{20}O$	156.16
12	Cocaine		$C_{17}H_{21}O_4N$	303.18
13	hydrochloride		$C_{17}H_{21}O_4N \cdot HCl$	339.64
14	Codeine	morphine methyl ether	$C_{18}H_{21}O_3N + H_2O$	317.19
15	hydrochloride		$C_{18}H_{21}O_3N \cdot HCl + 2H_2O$	371.67
16	phosphate		$C_{18}H_{21}O_3N \cdot H_3PO_4 + 2H_2O$	433.26
17	sulfate		$(C_{18}H_{21}O_3N)_2 \cdot H_2SO_4 + 5H_2O$	786.51
18	Collidine (α)	2-methyl-4-ethyl pyridine	$CH_3 \cdot C_5H_3N \cdot C_2H_5$	121.10
19	" (β)	4-methyl-3-ethyl pyridine	$CH_3 \cdot C_5H_3N \cdot C_2H_5$	121.10
20	" (γ)	2, 4, 6-trimethyl pyridine	$(CH_3)_3 \cdot C_5H_2N$	121.10
21	Coniferine		$C_{16}H_{22}O_8 + 2H_2O$	378.21
22	Coniferyl alcohol		$C_{10}H_{12}O_3$	180.10
23	Coniine (d.)	2-propyl piperidine	$2, C_5H_{10}N \cdot C_3H_7$	127.14
24	hydrochloride		$C_8H_{17}N \cdot HCl$	163.61
25	Conylene		C_8H_{14}	110.11
26	Cotarnine		$C_{12}H_{15}NO_4$	237.13
27	Coumalic acid		$C_5H_3O_2(COOH)$	140.03
28	Coumaric acid (o.)	hydroxycinnamic acid (o.)	$HO \cdot C_6H_4 \cdot CH : CH \cdot COOH$	164.06
29	" " (m.)	hydroxycinnamic acid (m.)	$HO \cdot C_6H_4 \cdot CH : CH \cdot COOH$	164.06
30	" " (p.)	hydroxycinnamic acid (p.)	$HO \cdot C_6H_4 \cdot CH : CH \cdot COOH$	164.06
31	Coumarilic acid	hydroxyphenyl-propiolic acid	$HO \cdot C_6H_4 \cdot C \equiv C \cdot COOH$	162.05
32	Coumarin	cumarin	$C_9H_6O_2$	146.05
33	Coumaron		C_8H_6O	118.05
34	Creatine	methylglycocy-amine	$NH : C(NH_2)N(CH_3) \cdot CH_2 \cdot COOH + H_2O$	149.11
35	Creatinine	methylglycocyami-dine	$C_4H_7ON_3$	113.08

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form and color	Sp. gr. H_2O = 1 (A)Air = 1	Melting-point °C	Boiling-point °C	Solubility in gms. per 100 c.c. of		
					Water	Alcohol	Ether
1	yel. leaf.	.....	112	.....	s. acet.	sl. s.	sl. s.
2	need.	1.040^{33}_{35}°	33	254	sl. s.	v. s.	v. s
3	cryst.	.....	35–6	170^{58mm}	.....	.....	.....
4	pl.	1.008	41	260–2	.....	s.	s.
5	monocl.	1.616	80	.....	v. s.	.....	.....
6	colorl. liq.	0.897	.....	228–9	i.	∞	∞
7	cryst.	.....	119	130 d.	s.	.....	.....
8	liq.	$0.85^{15°}$	.....	173–4	.....	s.	.....
9	colorl. rhomb.	$1.542^{18°}$	153	dec.	133 c.*	$116^{25°}$	2.26 c.
10	colorl. liq.	$0.854^{17.5°}$	.....	205–8	v. sl. s.	∞	∞
11	colorl. liq.	$0.856^{8°}$	.....	118^{17mm}	v. sl. s.	∞	∞
12	colorl. monocl.	.....	98	.....	$0.16^{25°}$; $0.38^{80°}$	$20^{25°}$	26.3
13	colorl. prisms	.....	186†	.....	$250^{25°}$	38.4^{25}	i.
14	colorl. orthorh.	.....	155 anh.	.....	$0.83^{25°}$; $1.7^{80°}$	$62.5^{25°}$	$8^{25°}$
15	colorl. need.	.....	264 anh.	.....	$3.84^{15°}$	.....	.....
16	colorl. need.	.....	235	.....	$44.5^{25°}$	$0.38^{25°}$	0.07
17	colorl. rhomb.	.....	278, d.	.....	$3.3^{25°}$	0.1^{25}	i.
18	colorl. liq.	$0.927^{16°}$	.....	179	s.	v. s.	v. s.
19	colorl. liq.	$0.966^{0°}$	.....	abt. 195	i.	s.	.....
20	colorl. liq.	0.917	.....	171–2	v. sl. s.	.....	.....
21	need.	.....	185	d.	s. h.	s.	i.
22	pr.	.....	73–4	.....	sl. s. h.	s.	s.
23	colorl. liq.	$0.844^{20°}$	–2	166–7	1.1 c.	∞	v. s.
24	colorl. rhomb.	.....	208–12	.....	50	s.	i.
25	.....	0.76^{15}	.....	125	.....	.....	.....
26	need.	.....	125	.....	sl. s.	s.	s.
27	pr.	.....	205–7	subl.	sl. s. c.	s.	sl. s.
28	colorl. need.	.....	208	dec.	sl. s.	v. s.	v. sl. s.
29	colorl. prisms	.....	191	.....	v. s. h.	.....	v. s.
30	colorl. need.	.....	206	.....	sl. s. c.; v. s. h.	v. s.	v. s.
31	need. f. w.	.....	192–3	d.	s. h.	s.	.....
32	colorl. rhomb.	.....	67	290–0.5	v. sl. s.; s. h.	v. s.	v. s.
33	liq.	1.078^{15}_{15}°	< –18	169–74	i.	s.	s.
34	colorl. monocl.	.....	d. 295–300	.....	$1.35^{1°}$	$0.008^{70°}$	i.
35	colorl. prisms f.w.	.....	d. abt. 270	.....	$8.7^{16°}$	0.16 c. abs.	.....

* Crystallizes from water with $1H_2O$. † Crystallized from alcohol.

No.	Name	Synonyms	Formula	Mol. wt.
1	Creosole		$CH_3 \cdot O \cdot C_6H_3 \cdot (CH_3) \cdot OH$, (1, 4, 2)	138.08
2	Cresol (o.)		$CH_3 \cdot C_6H_4 \cdot OH$	108.06
3	" (m.)		$CH_3 \cdot C_6H_4 \cdot OH$	108.06
4	" (p.)		$CH_3 \cdot C_6H_4 \cdot OH$	108.06
5	Cresotinic acid, 1, 4, 3		$C_6H_3(CH_3)(OH)COOH$	152.06
6	Cresotinic acid, 1, 3, 2		$C_6H_3(CH_3)(OH)COOH$	152.06
7	Cresotinic acid, 1, 3, 4		$C_6H_3(CH_3)(OH)COOH$	152.06
8	Croconic acid		$C_5O_3(OH)_2 + 3H_2O$	196.06
9	Crotonic acid (α)		$C_3H_5 \cdot COOH$	86.05
10	" " " (β)		$C_3H_5 \cdot COOH$	86.05
11	" aldehyde (α)		$C_3H_5 \cdot CHO$	70.05
12	Crotonyl alcohol		$CH_3 \cdot CH : CH \cdot CH_2OH$	72.06
13	Crotonylene	dimethylacetylene	$CH_3 \cdot C \vdots C \cdot CH_3$	54.05
14	Cubebine		$C_{10}H_{10}O_3$	178.08
15	Cumene	isopropylbenzene	$C_6H_5 \cdot CH(CH_3)_2$	120.10
16	Cumidic acid		$C_6H_2(CH_3)_2(COOH)_2$	194.08
17	Cumidine	p-isopropylamino-benzene	$(CH_3)_2CH \cdot C_6H_4 \cdot NH_2$	135.11
18	Cumidine, 1, 2, 4, 5	amino-isopropyl-benzene	$C_6H_4(C_3H_7)NH_2$	130.07
19	Cuminic acid (p.)		$(CH_3)_2CH \cdot C_6H_4 \cdot COOH$	164.10
20	Cumin alcohol (p.)		$C_6H_4 \cdot (C_3H_7) \cdot CH_2OH$	150.10
21	Cuminic aldehyde (p.)	p-isopropyl-benzaldehyde	$(CH_3)_2CH \cdot C_6H_4 \cdot CHO$	148.10
22	Curcumin		$C_{14}H_{14}O_4$	246.11
23	Cyamelide		$(CNOH)_n$	(43.02)
24	Cyan-acetic acid	nitrilomalonic acid	$CH_2 \cdot (CN) \cdot COOH$	85.03
25	Cyanamide		$CN \cdot NH_2$	42.03
26	Cyananilide		$CN \cdot NH \cdot C_6H_5$	118.06
27	Cyanethyl carbonate		$CN \cdot COOC_2H_5$	99.03
28	Cyanpropionic acid (α)		$CH_3 \cdot CH(CN) \cdot COOH$	99.03
29	Cyansulfide		$(CN)_2S$	84.08
30	Cyanogen		$N \vdots C \cdot C \vdots N$	52.03
31	bromide		$CNBr$	105.93
32	chloride		$CNCl$	61.47

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form and color	Sp. gr. $H_2O = 1$ (A)Air = 1	Melting-point °C	Boiling-point °C	Solubility in gms. per 100 c.c. of		
					Water	Alcohol	Ether
1	oil	$1.096^{\frac{18}{18}°}$	.....	220–2	sl. s.	∞	∞, ∞ bz.
2	colorl.	$1.051^{\frac{15}{15}°}$	30	190.8	$3.1^{35°}$	∞ abv. 30°	∞ abv. 30°
3	colorl. liq.	$1.039^{\frac{18}{18}°}$	4	202.8	$2.41^{25°}$	∞	∞
4	colorl. prisms	$1.039^{\frac{18}{18}°}$	36	201.8	$2.36^{40°}$	∞ abv. 36	∞ abv. 36
5	need. f. w.	.....	151	vol. in steam	s.	s.	s.
6	need. f. h. w.	.....	163–4	.....	s.	s.	s.
7	need. f. w.: monocl. f. al.	.....	177	236–7	s.	s.	s.
8	yel. leaf.	.....	100 anh.	.....	v. s.	s.	.....
9	colorl. monocl.	$0.973^{72°}$	72	185	8.3	.....	.....
10	colorl. need.	1.031	15.5	169.72, d.	40	s.	.....
11	colorl. liq.	$0.859^{14°}$	.....	104–5	s.	.....	.....
12	colorl. liq.	$0.873^{0°}$	.....	117	16.6	.....	.....
13	liq.	.....	.....	27	i.	.....	.....
14	need.	.....	125	not. volat.	v. sl. s.	$1.31^{12°}$	3.75
15	colorl. liq.	$0.862^{20°}$	.....	152.5–3.0	i.	s.	s.
16	long pr. f. bz. + al.	.....	subl.	.....	sl. s.	s. h.	.....
17	colorl. liq.	0.953	< –20	225	s. a.	.....	.....
18	.....	.....	41	257	s.	s.	s. bz.
19	colorl. tricl.	1.163[4°]	116.5	subl.	v. sl. s. c.	s.	v. s.
20	liq.	.....	.....	243	sl.s	s.	.....
21	colorl. liq.	$0.976^{\frac{25}{25}°}$	.....	235	i.	s.	s.
22	yel. pr.	.....	177–8	.....	s. alk.	s.	s.
23	wh. powd.	$1.127^{15°}$	.....	d.	i.	∞	∞
24	colorl.	.....	69–70	d.	s.	s.	s.
25	colorl. need.	.....	46(41–2)	.....	v. s.	v. s.	s.
26	need. f. eth.	.....	36–7	.....	sl. s.	s.	s.
27	liq.	$>H_2O$	.....	115–6	i.	s.	s.
28	yel. amor	.....	140 d.	.....	s.	s.	.....
29	rhombs.	.....	60	d.	s.	s.	s.
30	gas	1.806(A)	–34	–21	400 c.c.	v. s.	s.
31	colorl. need.	.....	52	61.5	s.	s.	s.
32	gas	.....	–5	15.5	2500 c.c.	10,000 c.c.	5,000 c.c

No.	Name	Synonyms	Formula	Mol. wt.
1	Cyanuramide	melamin	$C_3N_3(NH_2)_3$	126.1
2	Cyanuric acid		$H_3O_3N_3C_3 + 2H_2O$	165.0
3	Cyclo-hexane	hexanaphthene	C_6H_{12}	84.1
4	hexanol	hexahydrophenol	$(CH_2)_5 : CHOH$	100.
5	hexanone		$(CH_2)_5 : CO$	98.0
6	Cymene (1, 4)	p.-isopropyl toluene	$CH_3 \cdot C_6H_4 \cdot CH(CH_3)_2$	134.1
7	" (1, 2)	o.-isopropyl toluene	$CH_3 \cdot C_6H_4 \cdot CH(CH_3)_2$	134.1
8	" (1, 3)	m.-isopropyl toluene	$CH_3 \cdot C_6H_4 \cdot CH(CH_3)_2$	134.1
9	Dambose		$C_6H_6(OH)_6$	180.1
10	Daphnetin		$C_9H_6O_4$	178.0
11	Deca-hydro-naphthalene		$C_{10}H_{18}$	138.1
12	Deca-hydro-quinoline		$C_9H_7NH_{10}$	139.1
13	Decane (n.)		$CH_3 \cdot (CH_2)_8 \cdot CH_3$	142.1
14	Decyl alcohol (n.)		$CH_3 \cdot (CH_2)_8CH_2OH$	158.1
15	Decylene (n.)		$CH_3 \cdot (CH_2)_7 \cdot CH : CH_2$	140.1
16	Dehydracetic acid	6-methyl-3-aceto-pyronone	$CH_3 \cdot CO \cdot CHCOCH : C(CH_3)$ OCO	168.0
17	Desoxalic acid		$C_2H(OH)_2(COOH)_3$	194.0
18	Desoxybenzoïn		$C_6H_5 \cdot CO \cdot CH_2 \cdot C_6H_5$	196.1
19	Dextrin		$(C_6H_{10}O_5)x$	(162. 08)x
20	Dextrose	glucose, grape sugar	$C_6H_{12}O_6 + H_2O$	198.1
21	Diacetamide		$(CH_3 \cdot CO)_2NH$	101.0
22	Diacetanilide		$C_6H_5 \cdot N(COCH_3)_2$	177.1
23	Diacetin	glyceryl diacetate	$C_3H_5(OH)(OOC \cdot CH_3)_2$	176.1
24	Diacetoethylacetate		$(C_2H_3O)_2CH \cdot COOC_2H_5$	172.1
25	Diacetyl		$CH_3 \cdot CO \cdot CO \cdot CH_3$	86.0
26	Diacetylbenzaldehyde	benzylidene-diacetate	$C_6H_5 \cdot CH(C_2H_3O_2)_2$	208.1
27	Diacetylglucose		$C_6H_6(OC_2H_3O)_2(OH)_3C(OH)$	264.1
28	Diacetylhydroquinone		$C_6H_4(C_2H_3O_2)_2$	194.0
29	Diacetylene		$CH : C \cdot C : CH$	50.0
30	Di-allyl		$(C_3H_5)_2$	82.0
31	Dialuric acid	tartronylurea	$C_4H_4N_2O_4$	144.0
32	Diaminoanthraquinone (α)		$C_{14}H_6(NH_2)_2O_2$	238.1
33	Diaminoanthraquinone (β)		$C_{14}H_6(NH_2)_2O_2$	238.1
34	Diaminoanthraquinone (γ)		$C_{14}H_6(NH_2)_2O_2$	238.1

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form and color	Sp. gr. H_2O = 1 (A)Air = 1	Melting-point °C	Boiling-point °C	Solubility in gms. per 100 c.c. of		
					Water	Alcohol	Ether
1	monocl. pr.	.....	subl. d.	.....	sl. s.	i.	i.
2	colorl. monocl.	$1.768^{0°}$	.....	.....	$0.25^{17°}$	0.33 c.	v. sl. s.
3	colorl. liq.	$0.779^{20°}$ (0.790^{20})	6.4 (4.7)	80.8	i.	∞	∞
4	colorl.	$0.962^{20°}$	16 (24)	160–1	3.6	s.	s.
5	colorl. liq.	$0.947^{20°}$	.....	155–7	v. s.	s.	s.
6	colorl. liq.	$0.860^{16°}$	–73.5	175–6.5	i.	v. s.	s.
7	.....	0.858	.....	157	i.	s.	.....
8	.....	0.865	.....	175	i.	s.	.....
9	hex. pr.	.....	212	.....	v. s.	i. abs.	.....
0	yel. pr.	.....	253–6 d.	.....	v. s. h.	s. h.	v. sl. s.
1	colorl. liq.	$0.877^{20°}$	.....	189–91; (173–80)	i.	s.	s.
2	wh. pr.	.....	48	204	.....	.....	.....
3	colorl. liq.	$0.730^{20°}$	–30–2	173	i.	∞	∞
4	colorl. visc. liq.	$0.830^{20°}$	7	231	.....	s.	.....
5	colorl. liq.	$0.763^{0°}$	.....	172	i.	∞	∞
6	rhomb. pl.	.....	108	269	s.	s. h.	.....
7	liq.	.....	.....	d.	v. s.	s.	.....
8	pl.	.....	60	314	sl. s.	s.	s.
9	wh. amor.	1.038	.....	.....	v. s. h.	i.	i.
0	need. f. al.	$1.562^{18°}$	146 anh.	.....	$83^{17.5°}$	sl. s.	i.
	need. f. eth.	.....	78	223	s.	.....	.....
2	colorl. lvs.	.....	37–8	142^{11mm}	.....	.....	.....
	.....	$1.179\frac{8°}{8°}$	40	259–60	∞	v. s.	s.
	liq.	$1.064^{15°}$	.....	200–5 d.	sl. s.	.....	.....
	yel. liq.	$0.973^{22°}$	.....	87.5–8.0	$25^{15°}$	.....	.....
	.....	.....	44	220	.....	s.	.....
	.....	.....	<100	.....	s.	s.	s.
	.....	.....	123–4	.....	sl. s. h.	sl. s.	v. s.
	gas	.....	.....	.....	.....	.....	.....
	liq.	$0.6872^{17°}$	.....	59	i.	.....	.....
	tetr.	.....	.....	.....	sl. s.	.....	.....
	red need.	.....	236	subl.	v. sl. s.	i.	v. s. bz.
	br. red need.	.....	subl. abv. 300	.....	sl. s.	s.	s.
	.....	.....	d. 130	.....	i.	s.	.....

No.	Name	Synonyms	Formula	Mol. wt.
1	Diamino-azo-benzene (2, 4)		$(NH_2)_2 \cdot C_6H_3 \cdot N_2 \cdot C_6H_5$	212.1
2	-azo-benzene hydrochloride	chrysoidine orange	$C_6H_5 \cdot N_2 \cdot C_6H_3 \cdot (NH_2)_2HCl$	248.5
3	benzene (o.)		$C_6H_4 \cdot (NH_2)_2$	108.0
4	" (m.)		$C_6H_4 \cdot (NH_2)_2$	108.0
5	" (p.)		$C_6H_4 \cdot (NH_2)_2$	108.0
6	Diaminobenzoic acid, COOH, NH_2, NH_2, 1, 2, 3		$C_6H_3(NH_2)_2COOH$	152.0
7	Diaminobenzoic acid, COOH, NH_2, NH_2, 1, 3, 4		$C_6H_3(NH_2)_2COOH$	152.0
8	Diaminobenzoic acid, COOH, NH_2, NH_2, 1, 3, 5		$C_6H_3(NH_2)_2COOH$	152.0
9	Diaminobenzoic acid, COOH, NH_2, NH_2, 1, 3, 6		$C_6H_3(NH_2)_2COOH$	152.0
10	Diaminobenzophenone (4, 4′)	Mischler's ketone	$(C_6H_4NH_2)_2CO$	212.1
11	Diaminobenzophenone (3, 3)		$(C_6H_4NH_2)_2CO$	212.1
12	Diamino-diphenylamine (p.)		$NH(C_6H_4NH_2)_2$	199.1
13	Diamino-diphenyl methane (4, 4′)		$CH_2(C_6H_4 \cdot NH_2)_2$	198.1
14	Diamino-naphthalene (1, 2)	naphthylene diamine	$C_{10}H_6 \cdot (NH_2)_2$	158.1
15	Diamino-naphthalene (1, 5)	naphthylene diamine	$C_{10}H_6 \cdot (NH_2)_2$	158.1
16	Diamino-naphthalene (1, 8)	naphthylene diamine	$C_{10}H_6 \cdot (NH_2)_2$	158.1
17	Diaminophenol (2, 4)		$(NH_2)_2 \cdot C_6H_3(OH)$	124.0
18	hydrochloride	amidol	$HO \cdot C_6H_3 \cdot (NH_2)_2 \cdot 2HCl$	197.0
19	Diamino-stilbene		$C_2H_2(C_6H_4NH_2)_2$	210.1
20	Diamino-triphenyl methane (4, 4′)		$C_6H_5 \cdot CH(C_6H_4NH_2)_2$	274.1
21	Dianisidine		$C_{12}H_6(OCH_3)_2(NH_2)_2$	244.1
22	Diazo-amino-benzene		$C_6H_5 \cdot N_2 \cdot NHC_6H_5$	197.1
23	aminonaphthalene		$C_{10}H_7N_2NHC_{10}H_7$	297.1
24	benzene chloride		$C_6H_5 \cdot N_2Cl$	140.5
25	benzene cyanide		$C_6H_5 \cdot N_2CN + HCN$	158.0
26	benzeneimide		$C_6H_5 \cdot N_3$	119.0
27	benzene nitrate		$C_6H_5 \cdot N_2NO_3$	167.0
28	" sulfonic acid (o.)		$C_6H_4 : N_2SO_3$	184.1

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form and color	Sp. gr. $H_2O = 1$ (A) Air = 1	Melting-point °C	Boiling-point °C	Solubility in gms. per 100 c.c. of		
					Water	Alcohol	Ether
1	yel. need.	.....	117.5	.....	sl. s.	s.	s.
2	red brown	.....	.....	.....	v. s.	s.	.....
3	tab. f. chl.	.....	101.2	256–8	sl. s. c.; s. h.	v. s.	v. s.
4	rhombic	.....	63	283–4	s.	s.	s.
5	colorl. sc. f. bz.	.....	140	267	s.	s.	s.
6	lng. need.	.....	.....	d.	sl. s.	.....	.....
7	lvs.	.....	.....	210–1 d.	sl. s. c.; s. h.	.....	.....
8	l. need.	.....	abt. 240	d.	s. h.	v. s.	v. s.
9	sm. pr.	.....	.....	d.	v. sl. s.	v. sl. s.	v. sl. s.
10	yel. need.	.....	239	.....	s. h.	s.	s.
11	need.	.....	172	.....	.....	s.	s.
12	leaf.	.....	158	d.	.....	.....	.....
13	colorl. leaf.	.....	88	.....	.....	v. s.	s. bz.
14	colorl. rhomp. f. w.	.....	95–6	.....	s. h.	v. s.	v. s.
15	colorl. prisms f. eth.	.....	189.5	subl.	v. sl. s. c	v. s. chl	v. s.
16	colorl. f. al	.....	66.5	.....	sl. s.	v. s.	v. s.
17	colorl.	.....	78–80 d.	.....	s. alk.	.....	.....
18	gray-wh. cryst.	.....	.....	.....	s.	sl. s.	.....
19	leaf.	.....	170	subl. d.	sl. s.	s.	sl. s.
20	colorl. warts	.....	139	.....	v. sl. s.	v. s.	v. s.
21	need.	.....	168–72	.....	sl. s. h.	.....	sl. s.
22	yel. leaf. f. al.	.....	96	.....	i.	s. h.	v. s.
23	yel. lvs.	.....	expl.	.....	.....	.....	.....
24	colorl. need.	.....	d.	.....	v. s.	s.	i.
25	yel. pr.	.....	69	.....	sl. s.	.....	.....
26	yel. oil	.....	.....	expl. 59^{12mm}	i.	sl. s.	sl. s.
27	colorl. need.	.....	expl.	.....	v. s.	s.	i.
28	cryst.	.....	.....	.....	$0.0715^{25°}$	.....	.....

No.	Name	Synonyms	Formula	Mol. wt.
1	Diazo-benzene sulfonic acid (m.)	.....	$C_6H_4 : N_2SO_3$.....	184.1
2	benzene sulfonic acid (p.)	.....	$C_6H_4 : N_2SO_3$.....	184.1
3	ethylacetate....	.....	$CO_2C_2H_5CHN_2$.....	114.0
4	methane.....	.....	CH_2N_2.....	42.0
5	Dibenzyl.....	.....	$C_6H_5 \cdot CH_2 \cdot CH_2 \cdot C_6H_5$	182.1
6	amine.....	.....	$(C_6H_5 \cdot CH_2)_2NH$....	197.1
7	ketone.....	.....	$(C_7H_7)_2CO$.....	210.1
8	Dibrom-acetic acid	.....	$CHBr_2 \cdot COOH$.....	217.8
9	anthracene.....	.....	$C_{14}H_8Br_2$.....	335.9
10	anthraquinone (α)	.....	$C_{14}H_6Br_2O_2$.....	365.8
11	" (β)	.....	$C_6H_4(CO)_2C_6H_2Br_2$..	365.8
12	benzene (o.)....	.....	$C_6H_4Br_2$.....	235.8
13	" (m.)....	.....	$C_6H_4Br_2$.....	235.8
14	" (p.)....	.....	$C_6H_4Br_2$.....	235.8
15	succinic acid....	.....	$C_2H_2Br_2(COOH)_2$...	275.8
16	Dichlor-acetal....	.....	$CHCl_2 \cdot CH(OC_2H_5)_2$	187.0
17	acetamide.....	.....	$CHCl_2 \cdot CONH_2$.....	127.9
18	acetic acid.....	.....	$CHCl_2 \cdot COOH$.....	128.9
19	acetone (α).....	.....	$CHCl_2 \cdot CO \cdot CH_3$....	126.9
20	" (β).....	.....	$CH_2Cl \cdot CO \cdot CH_2Cl$..	126.9
21	acetyl chloride..	.....	$CHCl_2 \cdot COCl$.....	147.3
22	aldehyde.....	.....	$CHCl_2 \cdot CHO$.....	112.9
23	anthracene (9, 10)	.....	$C_{14}H_8Cl_2$.....	246.9
24	aniline (2, 4)....	.....	$NH_2 \cdot C_6H_3Cl_2$.....	161.9
25	" (2, 5)....	.....	$NH_2 \cdot C_6H_3Cl_2$.....	161.9
26	" (3, 4)....	.....	$NH_6 \cdot C_6H_3Cl_2$.....	161.9
27	" (3, 5)....	.....	$NH_6 \cdot C_6H_3Cl_2$.....	161.9
28	benzene (o.)....	.....	$C_6H_4Cl_2$.....	146.9
29	" (m.)...	.....	$C_6H_4Cl_2$.....	146.9
30	" (p.)....	.....	$C_6H_4Cl_2$.....	146.9
31	benzoic acid (2, 5)	.....	$Cl_2C_6H_3 \cdot COOH$....	190.9
32	" " (2, 6)	.....	$Cl_2C_6H_3 \cdot COOH$....	190.9
33	" " (3, 4)	.....	$Cl_2C_6H_3 \cdot COOH$....	190.9
34	diphenyl (p.)...	.....	$(C_6H_4Cl)_2$.....	222.9
35	ether.....	.....	$CH_2Cl \cdot CHCl \cdot OC_2H_5$	142.9
36	ethylene (asym.)	.....	$CH_2 : CCl_2$.....	96.9
37	" (sym.)	.....	$CHCl : CHCl$.....	96.9
38	hydrine (1, 3) (α)	.....	$CH_2Cl \cdot CHOH \cdot CH_2Cl$	128.9
39	" (2, 3) (β)	.....	$CH_2Cl \cdot CHCl \cdot CH_2OH$	128.9
40	methylarsine....	methylarsenic-dichloride	$AsCl_2CH_3$.....	160.9
41	methyl ether....	.....	$CH_2Cl \cdot O \cdot CH_2Cl$...	114.9
42	naphthalene (1, 4)	.....	$C_{10}H_6Cl_2$.....	196.9
43	" (1, 5)	.....	$C_{10}H_6Cl_2$.....	196.9

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form and color	Sp. gr. $H_2O = 1$ (A)Air = 1	Melting-point °C	Boiling-point °C	Solubility in gms. per 100 c.c. of		
					Water	Alcohol	Ether
1	red yel. pr. f. w.	.....	expl.	.....	v. s.	.....	.....
2	sm. need. f. w.	.....	.....	.....	v. s.$^{60°}$	i.	.....
3	.....	1.073$^{22°}$	.....	141	sl. s.	∞	∞
4	yel.	.....	.....	0; expl. 200	d.	s.	s.
5	colorl. monocl.	0.995	52	284	i.	s.	v. s.
6	liq.	1.033$^{14°}$	.....	d.	i.	v. s.	.....
7	.....	.....	30	230–1	.....	.....	.....
8	.....	.....	48	232	v. s.	v. s.	v. s.
9	yel. need.	.....	221	subl.	s. bz. h.	sl. s.	sl. s.
10	yel. need.	.....	236(145)	subl.	.....	sl. s.	s. bz.
11	yel. need.	.....	174	subl.	.....	v. sl. s.	s. bz.
12	colorl.	1.977$^{18°}$	−1	224	i.	s.	.....
12	colorl.	1.955$^{19°}$	1–2	219.5	i.	s.	s.
14	colorl. monocl.	2.220	89.3	219	i.	14$^{30°}$	.....
15	cryst.	.....	230 d.	.....	sl. s.	.....	.....
16	liq.	.....	.....	180–4	.....	.....	.....
17	monocl.	.....	98	233–4$^{755mm.}$	v. s. h.	v. s.	v. s.
18	colorl. liq.	1.572$^{13°}$	−4	190–1	s.	s.	s.
19	colorl. liq.	1.236$^{21°}$	.....	120	s.	s.	∞
20	.....	.....	45	172–4	.....	.....	.....
21	colorl. liq.	.....	.....	107–8	dec.	dec.	∞
22	colorl. liq.	.....	.....	88–90	i.	.....	.....
23	yel. need.	.....	209	.....	s. bz.	sl. s.	sl. s.
24	need....	.....	63	245	.....	s.	.....
25	need....	.....	50	251	.....	s.	.....
26	need....	.....	71.5	272	.....	s.	.....
27	need....	.....	505	259–60	i.	s.	.....
28	colorl. liq.	1.325$^{0°}$	.....	179	i.	s.	.....
29	colorl. liq.	1.307$^{0°}$	−18	172	i.	s.	s.
30	leaf. f. al.	1.268$^{15°}_{4°}$	53	172–4	.....	s.	v. s.
31	colorl. need.	.....	156	301	sl. s.; s. alk.	s.	.....
32	colorl. need.	.....	126.5	.....	s. alk.	.....	.....
33	colorl. need.	.....	203	.....	sl. s.; s. alk.	v. sl. s.	.....
34	pr.	.....	148	315	.....	.....	.....
35	.....	1.174$^{23°}$	.....	140–7	.....	.....	.....
36	.....	1.250$^{15°}$	.....	37	.....	.....	.....
37	.....	.....	.....	55	.....	.....	.....
38	colorl. liq.	1.367$^{19°}$	.....	174 (182)	1.1$^{19°}$	∞	∞
39	colorl. liq.	1.355$^{17.5°}$	.....	182–3	.....	.....	.....
40	liq.	.....	.....	133	.....	.....	.....
41	.....	1.315	.....	105	.....	.....	.....
42	need. f. al.	.....	67–8	287	i.	s.	s.
43	sc. f. al.	.....	107	subl.	i.	s.	s.

No.	Name	Synonyms	Formula	Mol. wt.
1	Dichlor-nitro-hydrine		$CH_2Cl \cdot CH(NO_3) \cdot CH_2Cl$	173.9
2	quinoline (o.)		$C_9H_5Cl_2N$	197.9
3	" (m.) N, Cl, Cl, 1, 1′, 3′		$C_9H_5Cl_2N$	197.9
4	quinoline (p.) N, Cl, Cl, 1, 1′, 4′		$C_9H_5Cl_2N$	197.9
5	quinone		$C_6H_2Cl_2O_2$	176.9
6	Dicyandiamide	param, cyanguanidine	$(CN)_2(NH_2)_2$ or $C(NH)NH_2NHCN$	84.0
7	Dicyandiamidine	guanylurea	$HN:C(NH_2)NHCONH_2$	102.0
8	Diethyl-acetic acid		$(C_2H_5)_2:CH \cdot COOH$	116.1
9	amine		$(C_2H_5)_2:NH$	73.1
10	aniline		$C_6H_5 \cdot N(C_2H_5)_2$	149.1
11	benzene (o.)		$C_6H_4(C_2H_5)_2$	134.1
12	" (m.)		$C_6H_4(C_2H_5)_2$	134.1
13	" (p.)		$C_6H_4(C_2H_5)_2$	134.1
14	carbinol		$(C_2H_5)_2CHOH$	88.1
15	cyanamide		$CN \cdot N(C_2H_5)_2$	98.1
16	ketone		$C_2H_5 \cdot CO \cdot C_2H_5$	86.0
17	methylcarbinol		$(C_2H_5)_2C(OH)CH_3$	102.1
18	oxamide (s.)		$(CO \cdot NHC_2H_5)_2$	144.1
19	phosphine		$(C_2H_5)_2PH$	90.1
20	phosphoric acid		$PO(OC_2H_5)_2OH$	154.1
21	propylcarbinol		$(C_2H_5)_2C(OH)C_3H_7$	130.1
22	toluene (1, 3, 5)		$(C_2H_5)_2:C_6H_3 \cdot CH_3$	148.1
23	urea (s.)		$C_2H_5NH \cdot CO \cdot NHC_2H_5$	116.1
24	" (uns.)		$NH_2 \cdot CO \cdot N(C_2H_5)_2$	116.1
25	Diethylenediamine	piperazine	$NH(C_2H_4)NHC_2H_4$	86.1
26	Diethyleneglycol		$(CH_2OH \cdot CH_2)_2O$	106.0
27	Digallic acid		$(HO)_3C_6H_2CO_2C_6H_2(OH)_2 \cdot COOH$	322.0
28	Diglycerol		$C_6H_{14}O_5$	166.1
29	Diglycolic acid		$O(CH_2 \cdot COOH)_2$	134.0
30	Dihydracrylic acid		$C_6H_6O_3$	126.0
31	Dihydro-anthracene		$C_6H_4:(CH_2)_2:C_6H_4$	180.1
32	benzene (1, 2)		C_6H_8	80.0
33	" (1, 4)		C_6H_8	80.0
34	carveol		$C_{10}H_{18}O$	154.1
35	carvone		$C_{10}H_{16}O$	152.1
36	cymene		$C_{10}H_{14}H_2$	136.1
37	ethylanthracene		$C_6H_4C_2H_3(C_2H_5) \cdot C_6H_4$	208.1
38	naphthalene (1, 4)		$C_{10}H_{10}$	130.0
39	quinoline		C_9H_9N	131.0
40	resorcinol		$C_6H_6O_2H_2$	112.0
41	toluene (1, 3)		$CH_3 \cdot C_6H_7$	94.0
42	xylene		C_8H_{12}	108.1
43	Dihydroxy-anthracene (α)	chrysazol	$C_{14}H_8(OH)_2$	210.0

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form and color	Sp. gr. $H_2O = 1$ (A)Air = 1	Melting-point °C	Boiling-point °C	Solubility in gms. per 100 c.c. of		
					Water	Alcohol	Ether
1	colorl.	1.459	.....	.....	i.	s.	s.
2	cryst.	.....	104–5	.....	i.	s.	s.
3	l. need.	.....	103–4	.....	.....	s.	.....
4	sh. need.	.....	92–3	.....	.....	s.	s.
5	yel. rhomb.	.....	120	.....	.....	.....	.....
6	.....	.....	205	d.	s.	s.	sl. s.
7	cryst.	.....	.....	.....	s.	s.	s. a.
8	colorl. liq.	$0.920^{18°}$	.....	190	sl. s.	.....	.....
9	colorl. liq.	$0.712^{15°}$	–40	55.5–6.0	v. s.	s.	s.
10	colorl. liq.	0.936	–38–9	216	v. sl. s.	s.	s.
11	colorl. liq.	$0.866^{18°}$	.....	185	i.	s.	s.
12	colorl. liq.	$0.860^{20°}$	.....	181–2	i.	s.	s.
13	colorl. liq.	$0.862^{18°}$	.....	182–3	i.	s.	s.
14	colorl. liq.	$0.832^{0°}$	.....	116.5	sl. s.	s.	s.
15	liq.	.....	.....	186	i.	s.	s.
16	colorl. liq.	$0.814^{20°}$	.....	102–7	s.	∞	∞
17	.....	.....	.....	120	.....	s.	.....
18	colorl. need.	.....	175	.....	sl. s.	s.	v. sl. s.
19	.....	$<H_2O$	.....	85	.....	.....	.....
20	liq.	$0.6872^{17°}$	.....	59	i.	.....	.....
21	.....	.....	.....	145–50	.....	.....	.....
22	colorl. liq.	$0.879^{20°}$	.....	199–200	i.	∞	∞
23	colorl. prisms	1.042	112	263	v. s.	v. s.	v. s.
24	colorl. prisms	.....	70–4	.....	v. s.	v. s.	s.
25	cryst.	.....	104	146	s.	.....	.....
26	.....	$1.132^{0°}$	.....	250	s.	s.	s.
27	amor.	.....	.....	.....	s.	i.	i.
28	.....	.....	.....	220–30	s. h.	.....	i.
29	rhomb. pr.	.....	150	d.	s.	s.	s.
30	.....	.....	d.	.....	s.	s.	s.
31	colorl. tricl.	.....	108.5	313	i.	v. s.	v. s.
32	colorl. liq.	$0.848^{20°}$	.....	82–5	i.	s.	v. s.
33	colorl. liq	$0.847^{20°}$	.....	85–6	i.	∞	∞
34	liq.	$0.927^{20°}$	.....	225	.....	.....	.....
35	liq.	$0.928^{15°}$	.....	222	.....	.....	.....
36	.....	.....	.....	174	.....	.....	.....
37	oil	$1.049^{18°}$	.....	320	i.	s.	s.
38	colorl. liq.	.....	15–5.5	212	i.	v. s.	v. s.
39	yel. cryst.	.....	220–6	.....	.....	.....	.....
40	pr.	.....	105	.....	.....	.....	.....
41	liq.	.....	.....	105–8	.....	.....	.....
42	liq.	.....	.....	135	.....	.....	.....
43	yel. lvs. or need.	.....	220 d.	.....	.....	s.	s. alk.

No.	Name	Synonyms	Formula	Mol. wt.
1	Dihydroxy-anthracene (β)	rufol	$C_{14}H_8(OH)_2$	210.08
2	benzene (o.)	See *catechol*		
3	" (m.)	See *resorcinol*		
4	" (p.)	See *quinol*		
5	benzoic acid (2, 3)		$(HO)_2 : C_6H_3 \cdot COOH + 2H_2O$	190.08
6	" " (2, 4)		$(HO)_2 : C_6H_3 \cdot COOH + 3H_2O$	208.10
7	" " (2, 5)		$(HO)_2 : C_6H_3 \cdot COOH$	154.05
8	" " (3, 5)		$(HO)_2 : C_6H_3 \cdot COOH + 1\frac{1}{2}H_2O$	181.07
9	" " (2, 6)	γ-resorcylic acid	$(HO)_2 : C_6H_3 \cdot COOH$	154.05
10	benzophenone (2, 4)		$C_6H_3(OH)_2 \cdot CO \cdot C_6H_5$	214.08
11	benzophenone (3, 3')		$[C_6H_4(OH)]_2CO$	214.08
12	benzophenone (4, 4')		$[C_6H_4(OH)]_2CO$	214.08
13	cinnamic acid		$(HO)_2C_6H_3 \cdot C_2H_2 \cdot COOH + \frac{1}{2}H_2O$	189.07
14	diphenylmethane (p.)		$CH_2(C_6H_4OH)_2$	200.10
15	naphthalene (1, 6)		$C_{10}H_6(OH)_2$	160.06
16	" (1, 7)		$C_{10}H_6(OH)_2$	160.06
17	" (1, 8)		$C_{10}H_6(OH)_2$	160.06
18	" (2, 3)		$C_{10}H_6(OH)_2$	160.06
19	" (1, 4)		$C_{10}H_6(OH)_2$	160.06
20	" (1, 2)		$C_{10}H_6(OH)_2$	160.06
21	" (1, 5)		$C_{10}H_6(OH)_2$	160.06
22	" (2, 6)		$C_{10}H_6(OH)_2$	160.06
23	" (2, 7)		$C_{10}H_6(OH)_2$	160.06
24	pyridine (2, 4)		$(HO)_2C_5H_3N$	111.05
25	" (2, 6)		$(HO)_2C_5H_3N + \frac{1}{2}H_2O$	120.06
26	quinone (2, 5)		$C_6H_2O_2(OH)_2$	140.03
27	stearic acid		$C_{18}H_{34}(OH)_2O_2$	316.29
28	tartaric acid		$COOH \cdot C(OH)_2C(OH)_2COOH$	182.05
29	terephthalic acid (2, 5)		$C_6H_2(OH)_2(COOH)_2 + H_2O$	216.06
30	toluene (2, 4)		$CH_3C_6H_3(OH)_2$	124.06
31	" (2, 5)		$CH_3C_6H_3(OH)_2$	124.06
32	" (2, 6)		$CH_3C_6H_3(OH)_2$	124.06
33	xylene (1, 3, 4, 6)		$C_6H_2(CH_3)_2(OH)_2$	138.08
34	" (1, 4, 2, 5)	hydrophloron	$C_6H_2(CH_3)_2(OH)_2$	138.08
35	" (1, 4, 2, 6)	β-orcin	$C_6H_2(CH_3)_2(OH)_2$	138.08
36	Diiodo-acetic acid		$CHI_2 \cdot COOH$	311.88
37	benzene (o.)		$C_6H_4I_2$	329.90
38	" (m.)		$C_6H_4I_2$	329.90
39	" (p.)		$C_6H_4I_2$	329.90

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form and color	Sp. gr. $H_2O = 1$ (A) Air = 1	Melting-point °C	Boiling-point °C	Solubility in gms. per 100 c.c. of		
					Water	Alcohol	Ether
1	yel. need.	.....	.....	.....	.....	s.	s. alk.
2							
3							
4							
5	colorl. need.	.....	204	dec.	s.	.....	.....
6	colorl. need.	.....	204–6 d. (213)	dec.	$0.26^{17°}$	v. s.	v. s.
7	colorl. need.	.....	199–200	dec.	v. s.	v. s.	v. s.
8	colorl. prisms	.....	232	.....	s.	v. s.	v. s.
9	colorl.	.....	148–67 d.	.....	s. alk.	.....	.....
10	pyram. f. bz.	.....	143–4	.....	s. h.	s. alk.	v. s.; s. bz.
11	sm. need.	.....	162–3	.....	s.	s.	s. alk.
12	yel. need. f. lgr.	.....	210	.....	v. s. h.	v. s.	v. s.; s. acet
13	yel. monocl. pr. or lvs.	.....	124 d.	.....	v. s.	v. s.	v. s.
14	lvs. or need.	.....	158	subl.	.....	s.	s.
15	colorl. pr.	.....	134–5	.....	.....	v. sl. s.	v. s.
16	colorl. need.	.....	178	.....	s.	v. s.	v. s.
17	need.	.....	140	.....	sl. s. h.	v. s. bz.	v. s.
18	rhomb. f. w.	.....	159	.....	s. h.	v. s.	v. s.
19	lng. need.	.....	176	.....	s. h.	s.	s.
20	.....	.....	60	.....	s.	.....	yel. in alk. sol.
21	sm. pr.	.....	259	.....	s. h.	s.	s.
22	leaf.	.....	215	subl.	sl. s.	s.	.....
23	need. or leaf.	.....	186	subl.	s.	s.	s. bz.
24	rhomb.	.....	260–5	.....	sl. s.	sl. s.	i.
25	yel. need.	.....	195	.....	sl. s.	sl. s.	v. sl. s.
26	yel. need.	.....	215–20	.....	i.	v. s.	v. sl. s
27	rhomb.	.....	126	.....	.....	s. h.	s.
28	wh. cryst.	.....	98	.....	.....	.....	.....
29	yel. need. or pr.	.....	d.	.....	s. h.	s.	s.
30	colorl.	.....	103–4	267–70	v. s.	v. s.	v. s.
31	colorl. leaf.	.....	124	subl.	v. s.	v. s.	v. s.
32	colorl. need.	.....	63–6	.....	v. s.	v. s.	.....
33	cryst.	.....	125	279	s.	v. s.	v. s.
34	leaf.	.....	212	subl.	sl. s.	s.	s.
35	tetrag.	.....	163	279	s.	s.	.....
36	yellow	.....	110	.....	sl. s.	.....	.....
37	prisms	.....	27	286.5	i.	s.	.....
38	rhomb.	.....	40.4	284.7	i.	s.	.....
39	leaf.	.....	129.4	285	i.	s.	.....

No.	Name	Synonyms	Formula	Mol. wt.
1	Diiso-amylamine		$[(CH_3)_2CH \cdot CH_2 \cdot CH_2]_2NH$	157.1
2	amyl ketone		$(C_5H_{11})_2CO$	170.1
3	butyl		$(CH_3)_2CH(CH_2)_2CH(CH_3)_2$	114.1
4	butylamine		$[(CH_3)_2CH \cdot CH_2]_2NH$	129.1
5	butylketone	valerone	$(C_4H_9)_2CO$	142.1
6	butyloxalate		$C_2O_4(C_4H_9)_2$	202.1
7	butylene		$(CH_3)_2C : CH \cdot C(CH_3)_3$	112.1
8	propyl carbinol		$(C_3H_7)_2CHOH$	116.1
9	propylethylene		$(CH_3)_2CH \cdot CH : CH \cdot CH(CH_3)_2$	112.1
10	propyl ketone		$(C_3H_7)_2CO$	114.1
11	Dimethyl acetic acid	See *isobutyric acid*		
12	aldehyde	ethylidene-dimethyl-ether	$CH_3 \cdot CH(OCH_3)_2$	90.0
13	amine		$(CH_3)_2NH$	45.0
14	anilin		$C_6H_5N(CH_3)_2$	121.1
15	anthracene (2, 3)		$C_{14}H_8(CH_3)_2$	206.1
16	" (2, 4)		$C_{14}H_8(CH_3)_2$	206.1
17	arsine		$(CH_3)_2AsH$	106.0
18	benzene	See *xlyenes*		
19	benzoic acid (2, 3)		$(CH_3)_2C_6H_3 \cdot COOH$	150.0
20	" " (2, 4)	xylic acid	$(CH_3)_2C_6H_3 \cdot COOH$	150.0
21	" " (2, 5)		$(CH_3)_2C_6H_3 \cdot COOH$	150.0
22	" " (2, 6)		$(CH_3)_2C_6H_3 \cdot COOH$	150.0
23	" " (3, 4)		$(CH_3)_2C_6H_3 \cdot COOH$	150.0
24	" " (3, 5)	mesitylinic acid (1, 3, 5)	$(CH_3)_2C_6H_3 \cdot COOH$	150.0
25	diethylmethane		$(CH_3)_2C(C_2H_5)_2$	100.1
26	ether	methyl ether	$CH_3 \cdot O \cdot CH_3$	46.0
27	ethyl acetic acid		$(CH_3)_2(C_2H_5) \cdot C \cdot COOH$	116.1
28	" benzene (2, 3, 5)		$C_2H_5 \cdot C_6H_3 \cdot (CH_3)_2$	134.1
29	" benzene		$C_2H_5 \cdot C_6H_3 \cdot (CH_3)_2$ (1, 3, 4)	134.1
30	ethylene		$CH_3 \cdot CH : CH \cdot CH_3$	56.0
31	glyoxime	diacetyldioxime	$(CH_3)_2C_2(NOH)_2$	116.0
32	hydroquinone		$C_6H_4(OCH_3)_2$	138.0
33	isobutylcarbinol		$(CH_3)_2C(OH)CH_2 \cdot CH(CH_3)_2$	116.1
34	isophthalate (1, 3)		$C_6H_4(COOCH_3)_2$	194.0
35	isopropylcarbinol		$(CH_3)_2(C_3H_7)COH$	102.1
36	naphthalene (α) (1, 4)		$C_{10}H_6(CH_3)_2$	156.1
37	" (β)		$C_{10}H_6(CH_3)_2$	156.1
38	naphthylamine (α)		$C_{10}H_7 \cdot N(CH_3)_2$	171.1
39	" (β)		$C_{10}H_7 \cdot N(CH_3)_2$	171.1
40	nitros amine		$(CH_3)_2N \cdot NO$	74.0

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form and color	Sp. gr. $H_2O = 1$ (A)Air = 1	Melting-point °C	Boiling-point °C	Solubility in gms. per 100 c.c. of		
					Water	Alcohol	Ether
1	colorl.	0.778	.....	190	sl. s	s.	∞
2	yel. liq.	.....	.....	226	i.	s.	s.
3	liq.	$0.7135^{0°}$	.....	108.5	.....	.....	.....
4	colorl. liq.	$0.7494^{0°}$	.....	139–40	v. sl. s.	s.	s.
5	liq.	$0.8332^{0°}$	.....	181–2	i.	.....	.....
6	colorl. liq.	$1.0021^{4°}$	.....	229	i.	s.	s.
7	.....	$0.734^{0°}$	.....	102.53	.....	.....	.....
8	colorl. liq.	$0.8292^{0°}$	.....	140	v. sl. s.	s.	s.
9	.....	.....	.....	116–20	.....	.....	.....
10	colorl.	$0.8062^{0°}$	.....	123.7	.....	s. bz.	.....
11							
12	.....	$0.8787^{0°}$	.....	64.4	.....	.....	.....
13	gas	$0.687^{-5.8°}$	.....	7.2	v. s.	s.	s.
14	yel. liq.	$0.9582^{0°}$	2.5	194	v. sl. s.	s.	s.
15	colorl. leaf.	.....	246	.....	.....	.....	v. s. bz.
16	need. f. al.	.....	71	.....	.....	s.	v. s. bz.
17	colorl. liq.	$1.2132^{9°}$	.....	36	∞ chl.	∞	∞
18							
19	colorl. prisms	.....	144	.....	v. sl. s. h.	s.	.....
20	colorl. monocl.	.....	126	268	v. sl. s. h.	v. s. h.	s.
21	colorl. need.	.....	132	268	v. sl. s. h.	v. s.	.....
22	need. f. al.	.....	97–9 (116)	274.5	sl. s.	.....	v. s.
23	colorl. prisms	.....	163	.....	v. sl. s. h.	v. sl. s.	.....
24	monocl. f. al.	.....	166	sub.	v. sl. s.	v. s.	.....
25	liq.	$0.7110^{0°}$	.....	66.7	.....	s.	s.
26	gas	1.617 (A)	−138.5	−24	3700 c.c.	s.	s.
27	colorl. liq.	.....	−14	187	v. sl. s.	s.	s.
28	colorl. liq.	$0.8612^{0°}$	.....	185	i.	.....	.....
29	colorl. liq.	$0.8782^{0°}$	.....	183.4	i.	.....	.....
30	.....	$0.6351^{3°}$	.....	+1	i. H_2SO_4	.....	.....
31	colorl.	.....	234.5	.....	i.	v. s.	v. s.
32	.....	.....	55–6	205	i.	.....	s. bz.
33	liq.	.....	.....	129–31	sl. s.	s.	s.
34	colorl.	.....	64.5	.....	i.	.....	.....
35	colorl. liq.	$0.8231^{9°}$	−14	117.6	s.	s.	.....
36	.....	$1.0176^{20°}$	.....	263	.....	.....	.....
37	.....	.....	.....	266	.....	.....	.....
38	colorl.	$1.0451^{\frac{15}{4}°}$	.....	276	i.	s.	s.
39	colorl.	$1.0462^{\frac{20}{4}°}$	46	305	i.	.....	.....
39	yel. liq.	.....	.....	153	i.	.....	.....

No.	Name	Synonyms	Formula	Mol. wt.
1	Dimethyl oxalate		$(COOCH_3)_2$	118.05
2	oxamide (s.)		$(CO\cdot NHCH_3)_2$	116.08
3	" (uns.)		$(CH_3)_2N\cdot CO\cdot CO\cdot NH_2$	116.08
4	phosphine		$(CH_3)_2PH$	62.08
5	phosphinic acid		$(CH_3)_2(OH)PO$	94.08
6	phthalate (o.)		$C_6H_4(COOCH_3)_2$	194.08
7	propyl carbinol		$(CH_3)_2(C_3H_7)COH$	102.10
8	pyridine.	See *lutidine*		
9	pyrrol		$(CH_3)C:CH\cdot CH:(CH_3)NH$	83.08
10	quinone (2, 3)		$(CH_3)_2C_6H_2O_2$	136.06
11	" (2, 5)		$(CH_3)_2C_6H_2O_2$	136.06
12	" (2, 6)		$(CH_3)_2C_6H_2O_2$	136.06
13	racemate		$C_4H_4O_6(CH_3)_2$	178.08
14	resorcinol		$C_6H_4(OCH_3)_2$	138.08
15	succinate		$C_2H_4\cdot(COO\cdot CH_3)_2$	146.08
16	sulfate		$(CH_3)_2SO_4$	126.11
17	tartrate (d. and l.)		$C_4H_4O_6(CH_3)_2$	178.08
18	terephthalate (p.)		$C_6H_4(COOCH_3)_2$	194.08
19	thetin		$(CH_3)_2S\cdot CH_2\cdot CO\cdot O$	120.13
20	thiophene (2, 4)		$(CH_3)_2C_4H_2S$	112.13
21	" (2, 5)		$(CH_3)_2C_4H_2S$	112.13
22	urea (sym.)		$CH_3NH\cdot CO\cdot NHCH_3$	88.08
23	" (uns.)		$NH_2\cdot CO\cdot N(CH_3)_2$	88.08
24	Dinaphthol (α)		$HO\cdot C_{10}H_6\cdot C_{10}H_6OH$	286.11
25	" (β)		$HO\cdot C_{10}H_6\cdot C_{10}H_6\cdot OH$	286.11
26	Dinaphthyl ($\alpha\,\alpha$)		$C_{10}H_7\cdot C_{10}H_7$	254.11
27	" ($\beta\,\beta$)		$C_{10}H_7\cdot C_{10}H_7$	254.11
28	Dinaphthylamine ($\beta\,\beta$)		$NH(C_{10}H_7)_2$	269.13
29	Dinaphthylketone (α)		$(C_{10}H_7)_2CO$	282.11
30	" (β)		$(C_{10}H_7)_2CO$	282.11
31	" (γ)		$(C_{10}H_7)_2CO$	282.11
32	Dinaphthylmethane (α)		$(C_{10}H_7)_2CH_2$	268.13
33	Dinaphthylmethane (β)		$(C_{10}H_7)_2CH_2$	268.13
34	Dinicotinic acid N, $(COOH)_2$ (1, 3, 5)	pyridine dicarboxylic acid	$C_5H_3N(COOH)_2$	167.05
35	Dinitraniline (2, 4)		$(NO_2)_2C_6H_3NH_2$	183.07
36	" (2, 6)		$(NO_2)_2C_6H_3NH_2$	183.07

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form and color	Sp. gr. $H_2O = 1$ (A)Air = 1	Melting-point °C	Boiling-point °C	Solubility in gms. per 100 c.c. of		
					Water	Alcohol	Ether
1	colorl. monocl.	.....	54	166.3	.....	.....	.....
2	colorl. need.	.....	209–10	.....	sl. s.	sl. s.	v. sl. s.
3	colorl. tab.	.....	104	.....	v. s.	v. s.	v. sl. s.
4	.....	.....	.....	25	i.	.....	.....
5	cryst.	.....	76	.....	s.	s.	s.
6	colorl. liq.	.....	.....	282	i.	.....	.....
7	colorl. liq.	.....	.....	123	v. sl. s.	s.	.....
8							
9	oil	.....	.....	165	v. sl. s.	s.	s.
10	yel. need.	.....	55	subl.	v. sl. s.	s.	s.
11	prisms	.....	125	subl.	sl. s. h.	sl. s.	v. s.
12	yel. need.	.....	72–3	.....	.....	.....	.....
13	monocl. f. al.	.....	85	282	.....	s.	.....
14	liq.	$1.075^{0°}$	–17	214	v. sl. s.	s.	s.
15	colorl.	1.126	18.5	195.2	i.	.....	.....
16	.....	.....	.....	188.5	.....	.....	.....
17	colorl.	1.340	48	280	s.	v. s.	s. chl.
18	need.	.....	140	.....	0.33	.....	.....
19	cryst.	.....	d.	.....	deliq.	s.	.....
20	.....	$0.996^{20°}$	.....	138	i.	s.	s.
21	.....	0.986	.....	135	i.	s.	s.
22	colorl. prisms	.....	100	268–73	v. s.	s.	i.
23	colorl. prisms	.....	180	.....	v. s.	v. sl. s.	v. sl. s.
24	rhombic	.....	300	.....	i.	s.	v. s.
25	need.	.....	218	subl.	i.	s.	v. s.
26	colorl. tab.	.....	154 (160.5)	abt. 360	v. s. bz.	s.	s.
27	colorl.	.....	187	.....	.....	sl. s.	.....
28	leaf.	.....	171	471	i.	sl. s.	s. bz.
29	need. f. al.	.....	135	.....	.....	s.	s.
30	need.	.....	125.5	.....	.....	1 : 267	.....
31	leaf.	.....	164.5	.....	.....	1 : 1250	.....
32	sm. pr. f. al.	.....	109	>360	s. chl.; s. bz.	1 : 15 h.	s.
33	sm. need.	.....	92	.....	.....	v. s.	s. bz.
34	.....	.....	323	.....	v. sl. s.	.....	.....
35	yel. monocl.	1.615	187.5–8.0	.....	i.	$0.7^{21°}$	.....
36	yel., lng. need.	.....	183	.....	.....	sl. s. h.	.....

No.	Name	Synonyms	Formula	Mol. wt.
1	Dinitro benzene(o.)		$C_6H_4(NO_2)_2$	168.05
2	" " (m.)		$C_6H_4(NO_2)_2$	168.05
3	" " (p.)		$C_6H_4(NO_2)_2$	168.05
4	benzoic acid (2, 4)		$(NO_2)_2 \cdot C_6H_3 \cdot COOH$	212.05
5	" " (2, 5)		$(NO_2)_2 \cdot C_6H_3 \cdot COOH$	212.05
6	" " (2, 6)		$(NO_2)_2 \cdot C_6H_3 \cdot COOH$	212.05
7	" " (3, 4)		$(NO_2)_2 \cdot C_6H_3 \cdot COOH$	212.05
8	" " (3, 5)		$(NO_2)_2 \cdot C_6H_3 \cdot COOH$	212.05
9	chlorbenzene (γ)		$C_6H_3Cl(NO_2)_2$	202.50
10	" (β) (1, 2, 4)		$C_6H_3Cl(NO_2)_2$	202.50
11	" (α) (1, 2, 4)		$C_6H_3Cl(NO_2)_2$	202.50
12	" (1, 3, 2)		$C_6H_3Cl(NO_2)_2$	202.50
13	" (1, 3, 4)		$C_6H_3Cl(NO_2)_2$	202.50
14	" (1, 3, 5)		$C_6H_3Cl(NO_2)_2$	202.50
15	cresol (p.)		$C_6H_2(NO_2)_2(CH_3)OH$	198.06
16	diphenyl (p.p.)		$NO_2C_6H_4 \cdot C_6H_4NO_2$	244.08
17	" (o.p.)		$NO_2C_6H_4 \cdot C_6H_4NO_2$	244.08
18	diphenylamine (o.p.)		$(C_6H_4NO_2)_2NH$	259.10
19	" (p.p.)		$(C_6H_4NO_2)_2NH$	259.10
20	methane		$CH_2(NO_2)_2$	106.03
21	naphthalene (α) (1, 5)		$C_{10}H_6(NO_2)_2$	218.06
22	" (β) (1, 8)		$C_{10}H_6(NO_2)_2$	218.06
23	" (γ) (1, 3)		$C_{10}H_6(NO_2)_2$	218.06
24	naphthol (α) (1, 2, 4)		$C_{10}H_5(NO_2)_2OH$	234.06
25	" (β)		$C_{10}H_5(NO_2)_2OH$	234.06
26	phenol (2, 3)		$(NO_2)_2 \cdot C_6H_3 \cdot OH$	184.05
27	" (2, 4)		$(NO_2)_2 \cdot C_6H_3 \cdot OH$	184.05
28	" (2, 6)		$(NO_2)_2 \cdot C_6H_3 \cdot OH$	184.05
29	" (3, 4)		$(NO_2)_2 \cdot C_6H_3 \cdot OH$	184.05
30	" (3, 5)		$(NO_2)_2 \cdot C_6H_3 \cdot OH$	184.05
31	resorcinol (2, 4, 1, 3)		$C_6H_2(NO_2)_2(OH)_2$	200.05
32	salicylic acid		$C_7H_4(NO_2)_2O_3 + H_2O$	246.06
33	toluene (2, 4)		$(NO_2)_2 \cdot C_6H_3 \cdot CH_3$	182.06
34	" (2, 5)		$(NO_2)_2 \cdot C_6H_3 \cdot CH_3$	182.06
35	" (2, 6)		$(NO_2)_2 \cdot C_6H_3 \cdot CH_3$	182.06
36	" (3, 4)		$(NO_2)_2 \cdot C_6H_3 \cdot CH_3$	182.06
37	" (3, 5)		$(NO_2)_2 \cdot C_6H_3 \cdot CH_3$	182.06
38	xylene (m.)		$C_8H_8(NO_2)_2$	196.08
39	" (p.)		$C_8H_8(NO_2)_2$	196.08
40	" (p. isomer)		$C_8H_8(NO_2)_2$	196.08

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form and color	Sp. gr. $H_2O = 1$ (A)Air = 1	Melting-point °C	Boiling-point °C	Solubility in gms. per 100 c.c. of		
					Water	Alcohol	Ether
1	tab. f. al.	$1.565^{17°}$	117	319	$0.38^{100°}$	$3.8^{25°}$	v. s. bz.
2	need. f. al.	$1.546^{17°}$	90	297	0.01 c.	$3.5^{20°}$	v. s.; v. s. bz.
3	need.	$1.587^{17°}$	171–2	298.4	$0.18^{100°}$	$0.4^{20°}$	s. bz.
4	colorl. pr. f. w.	.....	179	.....	$1.85^{25°}$	v. s.	$0.71^{30°}$ bz.
5	colorl. need.	.....	177	.....	sl. s. h.	.....	.....
6	colorl. need.	.....	202	dec.	v. s. h.	.....	.....
7	colorl.	.....	163–4	.....	$0.67^{25°}$	v. s.	v. s.
8	tab. f. w.	.....	203–4	.....	$1.9^{100°}$	v. s.	sl. s.
9	need.	.....	38.8	.....	.....	s.	s.
10	monocl.	.....	37.1 to γ	.....	.....	s.	.....
11	monocl.	.....	36.3 to γ	.....	.....	s.	.....
12	.....	$1.687^{16°}$	42	315	.....	v. s.	s.
13	.....	$1.697^{22°}$	50	315	.....	s.	.....
14	.....	.....	59	vol. in steam	.....	s.	s.
15	lng. yel. pr.	.....	84	.....	.....	.....	.....
16	need.	.....	233–5	.....	.....	s. h.	v. s.
17	monocl. need.	.....	93.5	.....	.....	s. h.	.....
18	red need.	.....	156–7	.....	.....	.....	.....
19	yel. pr.	.....	214	.....	.....	s.	.....
20	liq.	.....	.....	expl. 100	s.	.....	.....
21	hex. need.	.....	214	subl.	.....	sl. s.	.....
22	rhomb. pl.	.....	170	d.	.....	sl. s.	sl. s. bz.
23	yel. need.	.....	144	subl.	.....	.....	.....
24	yel. need.	.....	138	.....	v. sl. s. h.	sl. s.	s. acet. a.
25	yel. need.	.....	195	.....	v. sl. s.	s.	s.
26	yel. need. f. w.	.....	144	.....	sl. s.	v. s. h.	v. s.
27	yel. pl. f. w.	$1.683^{24°}$	114	.....	v.sl.s.c.; v. s. h.	$3.9^{19°}$	v. s.
28	yel. need. f. w.	.....	61.8	.....	v.sl.s.c.; v. s. h.	v. s. h.	v. s.
29	need.	.....	134	.....	.....	.....	.....
30	leaf.	.....	122	.....	.....	.....	.....
31	yel. lvs.	.....	142	subl.	.....	s.	.....
32	pl. or need.	.....	165 anh.	subl.	v. s. h.	.....	.....
33	need. f. al.	$1.321^{0°}$	70.7	.....	v. s. s. c.	sl. s.	v. s.
34	need. f. al.	.....	52	.....	v. s. CS_2	v. s.	v. s. bz.
35	need.	.....	66	.....	.....	s.	.....
36	need. f. CS_2	1.32	61	.....	i.	s.	2.19 c. CS_2
37	need. f. w.	.....	92–3	.....	v. sl. s.	s.	v. s.
38	lng. pr.	.....	93	.....	.....	s. h.	.....
39	sm. need.	.....	123.6	.....	.....	sl. s.	.....
40	rhbdr.	.....	9.3	.....	.....	s.	.....

No.	Name	Synonyms	Formula	Mol. wt.
1	Dioxindole		$C_6H_4CH(OH)CO\cdot NH$	149.06
2	Diphenic acid		$(C_6H_4\cdot COOH)_2$	242.08
3	Diphenol (α) (o. o.)		$(HO\cdot C_6H_4)_2$	186.08
4	" (β) (m. m.)		$(HO\cdot C_6H_4)_2$	186.08
5	" (γ) (p. p.)		$(HO\cdot C_6H_4)_2$	186.08
6	" (δ)		$(HO\cdot C_6H_4)_2$	186.08
7	Diphenyl		$C_6H_5\cdot C_6H_5$	154.08
8	acetic acid		$(C_6H_5)_2\cdot CH\cdot COOH$	212.10
9	amine		$(C_6H_5)_2\cdot NH$	169.10
10	benzene (p.)		$C_6H_5\cdot C_6H_4\cdot C_6H_5$	230.11
11	carbinol	benzhydrol	$(C_6H_5)_2CHOH$	184.10
12	dicarboxylic acid		$C_{12}H_8(COOH)_2$	242.08
13	ethane (α)		$CH_3\cdot CH(C_6H_5)_2$	182.11
14	hydrazine (α, α)		$(C_6H_5)_2N\cdot NH_2$	184.11
15	ketone	See *benzophenone*		
16	methane		$(C_6H_5)_2CH_2$	168.10
17	mustard oil		$C_{12}H_9NCS$	211.14
18	thiourea (sym.)	thiocarbanilide	$CS(NHC_6H_5)_2$	228.18
19	tolylmethane (m.)		$(C_6H_5)_2CH(C_6H_4CH_3)$	258.14
20	oxide		$(C_6H_4)_2O$	168.06
21	Diphenylol		$C_6H_5\cdot C_6H_5OH$	171.09
22	urea (uns.)	carbanilide	$NH_2\cdot CO\cdot N\cdot(C_6H_5)_2$	212.11
23	Dipicolinic acid (2, 6)		$C_5H_3N(COOH)_2 + 1\frac{1}{2}H_2O$	194.07
24	Dipropargyl		$CH\vdots C\cdot CH_2\cdot CH_2\cdot C\vdots CH$	78.05
25	Dipropyl amine		$(C_3H_7)_2NH$	101.13
26	carbinol		$(C_3H_7)_2\cdot CHOH$	116.13
27	ether	propyl ether	$C_3H_7\cdot O\cdot C_3H_7$	102.11
28	ketone	butyrone	$C_3H_7\cdot CO\cdot C_3H_7$	114.11
29	Dipyridine		$C_{10}H_{10}N_2$	158.10
30	Dipyridyl (p. p.)		$C_5H_4N\cdot C_5H_4N + 2H_2O$	192.11
31	Diquinoline		$C_9H_7N\cdot C_9H_7N$	258.13
32	Diquinoyl (2, 3')		$(C_9H_6N)_2$	256.11
33	" (6, 6')		$(C_9H_6N)_2$	256.11
34	" (7, 2')		$(C_9H_6N)_2$	256.11
35	Diresorcinol		$(HO)_2C_6H_3\cdot C_6H_3(OH)_2 + 2H_2O$	254.11
36	Dithiocarbamic acid		$NH_2\cdot CS_2H$	93.16
37	Ditolyl (o. o.)		$CH_3\cdot C_6H_4\cdot C_6H_4\cdot CH_3$	182.11
38	" (o. m.)		$CH_3\cdot C_6H_4\cdot C_6H_4\cdot CH_3$	182.11
39	" (m. m.)		$CH_3\cdot C_6H_4\cdot C_6H_4\cdot CH_3$	182.11

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form and color	Sp. gr. $H_2O = 1$ (A) Air = 1	Melting-point °C	Boiling-point °C	Solubility in gms. per 100 c.c. of		
					Water	Alcohol	Ether
1	rhomb. pr.	.....	180	195 d.	1 : 13; h. 1 : 6	1 : 15	s. alk.
2	need.	.....	226	subl.	sl. s.	s.	s.
3	lng. need.	.....	123	.....	s. h.	s.	s.
4	sm. leaf.	.....	190	.....	v. sl. s.	s.	s.
5	leaf. f. al.	.....	269–70	subl.	sl. s.	s.	s.
6	sm. need.	.....	161	342	sl. s. h.	s.	s.
7	colorl. tab.	1.165	70.5	254.6	i.	10 c.	s.
8	colorl. need.	.....	148	.....	v. s. h.	v. s.	v. s.
9	colorl. scales	1.159	54	302 (310)	v. sl. s.	v. s.	v. s.
10	colorl. leaf.	.....	205	383	s. h. bz.	v. sl. s.	sl. s.
11	need.	.....	67.5–8.0	297–8	0.05 c.	v. s.	v. s.
12	amor. powd.	.....	.....	d.	i.	i.	i.
13	oil	.....	.....	268–71	.....	.....	.....
14	tricl. f. lgr.	1.190	34.5 (44)	220^{40mm}	v. sl. s.	v. s.	v. s.
15							
16	colorl.	$1.001^{26°}$	26–7	261–2	v. sl. s.	v. s.	v. s.
17	need.	.....	58	.....	.....	.....	v. s.
18	leaf.	1.31	154	.....	.....	s.	s.
19	.....	.....	59.0–9.5	>360	s. bz.	sl. s. c.	s.
20	sm. lvs. f. al.	.....	80–1	287–8	i.	.....	s.
21	need. or leaf.	.....	165	305–8	.....	v. s.	v. s.
22	colorl. need.	.....	189	.....	v. sl. s.	s.	s.
23	colorl. need.	.....	226 d.	.....	v. sl. s.	v. sl. s.	.....
24	liq.	0.805	−6	85	i.	s.	v. s.
25	colorl. liq.	$0.736^{25°}$	.....	110	s.	s.	.....
26	colorl. liq.	$0.820^{20°}$	.....	154	.....	s.	s.
27	colorl. liq.	$0.744^{21°}$	.....	90.7	s.	∞	∞
28	colorl. liq.	0.821	.....	144	i.	∞	∞
29	need. f. h. w.	.....	108	subl. need.	sl. s. c.; s. h.	s.	s.
30	need.	.....	73; anh. 115	305	v. sl. s.	v. s.	v. s.
31	yel. need.	.....	114	.....	i.	v. s.	v. s.
32	monocl. tab.	.....	176–7	>400	i.	v. s.	sl. s.
33	monocl. tab. f. al.	....	178	dist.	v. sl. s. h.	v. sl. s.	v. sl. s.
34	monocl. tab. f. al.	.....	192.5	subl.	i.	v. sl. s.	sl. s.
35	cryst.	.....	310	.....	s. h.	i. acet.	s.
36	colorl. need.	.....	.....	.....	s.	s.	s.
37	colorl. liq.	.....	.....	272	i.	.....	.....
38	colorl. liq.	.....	.....	288	i.	v. s.	v. s.
39	colorl. liq.	.....	.....	280–1	i.	.....	.....

No.	Name	Synonyms	Formula	Mol. wt.
1	Ditolyl (p. p.)		$CH_3 \cdot C_6H_4 \cdot C_6H_4 \cdot CH_3$	182.11
2	Ditolyl amine (o.)		$(CH_3C_6H_4)_2NH$	197.13
3	" " (m.)		$(CH_3C_6H_4)_2NH$	197.13
4	" " (p.)		$(CH_3C_6H_4)_2NH$	197.13
5	Diurea	urazine	$CO(NH \cdot NH)_2CO$	116.06
6	Dodecane (n.)		$CH_3(CH_2)_{10} \cdot CH_3$	170.21
7	Dodecylene		$C_{12}H_{24}$	168.19
8	Dulcite		$C_6H_8(OH)_6$	182.11
9	Ecgonine (l.)		$C_9H_{15}O_3N + H_2O$	203.14
10	hydrochloride		$C_9H_{15}O_3N \cdot HCl$	221.59
11	Echitine		$C_{32}H_{52}O_2$	468.42
12	Eicosan		$C_{20}H_{42}$	282.34
13	Elaeomargaric acid		$C_{17}H_{30}O_2$	266.24
14	Elaeostearic acid		$C_{17}H_{30}O_2$	266.24
15	Elaïdic acid		$C_{17}H_{33}COOH$	282.27
16	Elaterin		$C_{20}H_{28}O_5$	348.22
17	Ellagic acid		$COC_6H(OH)_2C_6(OH)_2 \cdot OCO + 2H_2O$	338.08
18	Emetin		$C_{33}H_{40}N_2O_5$	544.34
19	Emodin	trihydroxymethyl-anthraquinone	$C_{14}H(CH_3)(OH)_2O_2$	267.06
20	Eosine	tetrabromfluores-cein	$C_{20}H_8O_5Br_4$	647.73
21	Eosine (dye)	alkali salt of above	$C_{20}H_6O_5Br_4Na_2$	691.70
22	Epichlorhydrine (α)	chloropropylene oxide	C_3H_5ClO	92.50
23	Epicyanhydrine		C_3H_5OCN	83.05
24	Epidichlorhydrine (α)		$C_3H_4Cl_2$	110.95
25	Epiiodohydrine		C_3H_5IO	183.97
26	Erucic acid		$C_{21}H_{41}COOH$	338.34
27	Erythrosine	tetraiodofluores-cein	$C_{20}H_8O_5I_4$	835.79
28	Erythrosine (dye)	alkali salt of above	$C_{20}H_6O_5I_4Na_2$	879.77
29	Eserin		$C_{15}H_{21}N_3O_2$	275.19
30	Ethane		$CH_3 \cdot CH_3$	30.05
31	Ethenyl-amino-phenol		$C_6H_4N : C(CH_3)O$	133.06
32	aminothiophenol		$C_6H_4N : C(CH_3)S$	149.13
33	diphenylamidine		$CH_3C(:NC_6H_5) \cdot NHC_6H_5$	210.13
34	tricarboxylic acid		$CH_3 \cdot C(COOH)_3$	162.05
35	triethyl ether		$CH_3 \cdot C(OC_2H_5)_3$	162.14
36	Ether	diethyl ether	$C_2H_5 \cdot O \cdot C_2H_5$	74.08
37	Ethoxy-benzoic acid (o.)		$C_2H_5 \cdot O \cdot C_6H_4 \cdot COOH$	166.08
38	Ethoxy-benzoic acid (m.)		$C_2H_5 \cdot O \cdot C_6H_4 \cdot COOH$	166.08
39	Ethoxy-benzoic acid (p.)		$C_2H_5 \cdot O \cdot C_6H_4 \cdot COOH$	166.08

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form and color	Sp. gr. $H_2O = 1$ (A)Air = 1	Melting-point °C	Boiling-point °C	Solubility in gms. per 100 c.c. of		
					Water	Alcohol	Ether
1	colorl. pr. f. eth.	.....	121	.....	.....	s.	s.
2	liq.	.....	.....	313–4	v. sl. s.	.....	.....
3	liq.	.....	.....	319–20	i.	v. s.	v. s.
4	colorl. need.	.....	79	330.5	v. sl. s.	.....	.....
5	pr.	.....	270	.....	sl. s.	sl. s.	.....
6	colorl. liq.	0.768^{20}	–12	214.5	i.	v. s.	v. s.
7	colorl. liq.	0.785^{20}	–31.5	213–5	i.	v. s.	v. s.
8	colorl. pr.	1.466	188.5	.....	4 c.; v. s. h.	v. sl. s.	v. sl. s.
9	colorl. pr.	.....	198 d.	.....	$21.7^{17°}$	1.5	v. sl. s.
10	tricl. pl.	.....	246	.....	s.	sl. s.	.....
11	leaf.	.....	170	.....	.....	v. s. h.	sl. s.
12	.....	$0.777^{37°}$	37	205^{15mm}	.....	.....	.....
13	rhomb. pl.	.....	48	.....	.....	s.	v. s.
14	leaf.	.....	71	.....	.....	s.	v. s.
15	colorl. leaf.	$0.851^{79°}$	51.5	234^{15mm}	i.	s.	s.
16	hex. pl.	.....	200	.....	i.	s.	sl. s.
17	yel. cryst.	$1.667^{18°}$	d.	.....	v. sl. s. h.	sl. s.	i.
18	.....	.....	68	.....	0.1	s.	.....
19	or. monocl. pr.	.....	245–50	.....	s.	s. glac. acet. a.	.....
20	red need.	.....	.....	.....	i.	s.	s. acet. a.
21	red to br. powd.	.....	.....	.....	s.	s.	.....
22	colorl. liq.	$1.203^{0°}$	.....	117	i.	∞	∞
23	pr.	.....	162	.....	s. h.	.....	.....
24	colorl. liq.	$1.209^{25°}$	.....	96	i.	∞	∞
25	.....	$2.03^{13°}$	.....	160–80	i.	.....	.....
26	colorl. need.	$0.860^{55°}$	33.4	264^{15mm}	.....	v. s.	.....
27	yel. cryst.	.....	.....	.....	i.	s.	v. sl. s.
28	red-br. powd.	.....	.....	.....	s.	s.	.....
29	.....	.....	106	.....	sl. s.	v. s.	s. bz.
30	gas.....	1.049 (A)	–172	–86	sl. s.	46 c.c.$^{4°}$	.....
31	liq.	$1.136^{0°}$	.....	201	i.	s.	.....
32	liq.	.....	.....	238	i.	s.	.....
33	need.	.....	131–2	.....	.....	sl. s. c.; v. s. h.	v. s.
34	pr.	.....	159 d.	.....	s.	s.	s.
35	.....	$0.94^{22°}$	.....	142	d. h.	.....	.....
36	colorl. liq.	0.719	–116.2	35	$8.3^{17.5}$	∞	.....
37	colorl.	.....	19.4	.....	sl. s.	.....	.....
38	colorl. need.	.....	137	sub.	sl. s. h.	s.	s.
39	colorl. need.	.....	195	.....	v. sl. s. h.	.....	.....

PHYSICAL CONSTANTS OF

No.	Name	Synonyms	Formula	Mol. wt.
1	Ethoxyl-amine		$CH_2OH \cdot CH_2NH_2$	61.06
2	aniline		$C_6H_5NH(C_2H_4OH)$	137.10
3	piperidine		$C_5H_{10}N \cdot C_2H_4OH$	129.13
4	Ethyl-acetamide		$C_2H_3O \cdot NH \cdot C_2H_5$	87.08
5	acetate		$CH_3COOC_2H_5$	88.06
6	acetoacetate	acetoacetic ether	$CH_3 \cdot CO \cdot CH_2 \cdot CO_2 \cdot C_2H_5$	130.08
7	acetylene		$C_2H_5 \cdot C : CH$	54.05
8	acrylate		$C_3H_3OO \cdot C_2H_5$	100.06
9	alcohol		$C_2H_5 \cdot OH$	46.05
10	allophanate		$NH_2CONHCOOC_2H_5$	132.08
11	allyl		$C_3H_5 \cdot C_2H_5$	70.08
12	allyl ether		$C_2H_5O \cdot CH_2 \cdot CH : CH_2$	86.08
13	amine		$C_2H_5 \cdot NH_2$	45.06
14	aminobenzoic acid		$C_2H_5 \cdot NH \cdot C_6H_4 \cdot COOH$	165.10
15	aminophenol		$HO \cdot C_6H_4 \cdot NH \cdot C_2H_5$	137.10
16	amylketone		$C_2H_5 \cdot CO \cdot C_5H_{11}$	128.13
17	aniline		$C_6H_5 \cdot NH \cdot C_2H_5$	121.10
18	anthracene		$C_6H_4C_2H(C_2H_5) \cdot C_6H_4$	206.11
19	benzalacetoacetate		$CH_3COC : (CHC_6H_5) COO \cdot C_2H_5$	218.11
20	benzene	phenylethane	$C_6H_5 \cdot C_2H_5$	106.08
21	benzoate		$C_6H_5 \cdot COO \cdot C_2H_5$	150.08
22	benzoic acid (o.)		$C_2H_5 \cdot C_6H_4 \cdot COOH$	150.08
23	" " (m.)		$C_2H_5 \cdot C_6H_4 \cdot COOH$	150.08
24	" " (p.)		$C_2H_5 \cdot C_6H_4 \cdot COOH$	150.08
25	benzoyl-acetate	benzoyl acetic ester	$C_6H_5 \cdot CO \cdot CH_2 \cdot COO \cdot C_2H_5$	192.10
26	benzylbenzene		$C_6H_5CH_2 \cdot C_6H_4 \cdot C_2H_5$	196.13
27	benzyl ether		$C_2H_5 \cdot O \cdot CH_2 \cdot C_6H_5$	136.10
28	" ketone		$C_2H_5 \cdot CO \cdot CH_2 \cdot C_6H_5$	148.10
29	brom-acetate		$CH_2Br \cdot COO \cdot C_2H_5$	166.97
30	bromide	monobromethane	C_2H_5Br	108.96
31	butyl ether (n.)		$C_2H_5 \cdot O \cdot C_4H_9$	102.11
32	" ketone (n.)		$C_2H_5 \cdot CO \cdot C_4H_9$	114.11
33	butyrate		$C_3H_7 \cdot COO \cdot C_2H_5$	116.10
34	caprate		$C_9H_{19}COOC_2H_5$	200.19
35	caproate		$C_5H_{11}COOC_2H_5$	144.13
36	caprylate		$C_7H_{15}COOC_2H_5$	172.16
37	carbamate	See *urethane*		
38	carbazole		$C_{12}H_8N \cdot C_2H_5$	195.11
39	carbonate		$(C_2H_5)_2CO_3$	118.08
40	carbostyril		$C_6H_4 \cdot C_2H_3(C_2H_5) NHCO$	174.10
41	chloracetate		$CH_2Cl \cdot COOC_2H_5$	122.51
42	chloracetoacetate		$CH_2Cl \cdot CO \cdot CH_2 COOC_2H_5$	164.53
43	chlorocarbonate		$Cl \cdot COOC_2H_5$	108.50
44	chlorformate	ethyl chlorcarbonate	$ClCOO \cdot C_2H_5$	108.50

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form and color	Sp. gr. $H_2O = 1$ (A)Air = 1	Melting-point °C	Boiling-point °C	Solubility in gms. per 100 c.c. of		
					Water	Alcohol	Ether
1	.....	.....	100 hyd	rochlori	de	.....	.....
2	liq.	$1.11^{0°}$	.....	280	v. sl. s.	s.	.. ....
3	liq.	.....	.....	199	s.	s.	.....
4	.....	$0.942^{4°}$	.....	205	.....	.....	s. a.
5	colorl. liq.	$0.900^{20°}$	−82.4	77	$8.6^{20°}$	∞	∞
6	liq.	$1.030^{15°}$	.....	181	sl. s.	s.	s.
7	colorl.	.....	−130	18	i.	s.	s.
8	colorl. liq.	$0.939^{0°}$	.....	98.5	.....	.....	.....
9	colorl. liq.	$0.789^{20°}$	−114	78.4	∞	.....	∞
10	need.	.....	190	d.	i. c.	.....	sl. s.
11	liq.	.....	.....	37	.....	.....	.....
12	colorl. liq.	$0.799^{25°}$	.....	66	i.	∞	∞
13	colorl. liq	0.689	−84	abt. 19	∞	∞	∞
14	pr.	.....	112	subl.	v. sl. s.	s.	s.
15	rhomb.	.....	167.5	.....	i.	s.	sl. s.
16	colorl. liq.	$0.850^{0°}$	.....	170	i.	∞	∞
17	liq.	$0.963^{20°}$	−80	205	v. sl. s.	∞	∞
18	leaf.	.....	60–1	.....	i.	s.	.....
19	.....	.....	59	181^{17mm}	... ..	s.	s.
20	colorl. liq.	$0.874^{14°}$	−94	136.5	i.	∞	∞
21	colorl. liq.	1.051	.....	212	sl. s. h.	s.	∞
22	colorl. need.	.....	68	259	v. sl. s.	v. s.	v. s.
23	colorl. need.	.....	47	.....	v. sl. s.	.....	.....
24	colorl. leaf.	.....	112–3	.....	s. h.	v. s.	v. s.
25	colorl. liq.	1.121	.....	265–70 d.	i.	∞	∞
26	liq.	$0.985^{19°}$	.....	294–5	.....	s.	s.
27	colorl. liq.	$0.950^{18°}_{15°}$	.....	185(189)	i.	∞	∞
28	colorl. liq.	$0.998^{17.5°}$	.....	223–6 (230)	i.	∞	∞
29	colorl. liq.	$1.507^{18°}_{4°}$	.....	158–60	i.	∞	∞
30	colorl. liq.	1.450	.....	39	$0.09^{20°}$	∞	∞
31	colorl. liq.	$0.752^{20°}$	.....	92	i.	∞	∞
32	colorl. liq.	.....	.....	147–8	i.	∞	∞
33	colorl. liq.	0.886	−93.3	119.9	$0.68^{25°}$	s.	s.
34	liq.	0.862	.....	243	.....	.....	.....
35	liq.	$0.8888^{0°}$	.....	166.6	i.	s.	s.
36	liq.	0.8738	.....	60	d.	.....	.....
37							
38	leaf.	.....	68	.....	.....	s. h.	s.
39	colorl. liq.	0.978	.....	126	i.	s.	.....
40	cryst.	.....	168	.....	.....	.....	.....
41	colorl. liq.	$1.159^{20°}$	.....	145.5	i.	.....	.....
42	colorl. liq.	$1.179^{15°}_{25°}$	.....	196–200	v. sl. s.	∞	∞
43	liq.	$1.139^{15°}$	.....	94	d.	.....	.....
44	colorl. liq.	1.139	.....	93	dec.	∞	∞

No.	Name	Synonyms	Formula	Mol. wt.
1	Ethyl-chloride		C_2H_5Cl	64.50
2	chlorpropionate (α)		$CH_3 \cdot CHCl \cdot COO \cdot C_2H_5$	136.53
3	cinnamate		$C_6H_5 \cdot CH : CH \cdot COO \cdot C_2H_5$	176.10
4	crotonic acid		$CH_3 \cdot C_2H(C_2H_5) COOH$	114.08
5	cyanacetate		$CH_2CN \cdot COOC_2H_5$	113.06
6	cyanate		$NCO(C_2H_5)$	71.05
7	cyanide	propionitrile	C_2H_5CN	55.05
8	diaceto-acetate		$(CH_3 \cdot CO)_2CH \cdot COO \cdot C_2H_5$	172.10
9	dichloracetate		$CHCl_2 \cdot COO \cdot C_2H_5$	156.96
10	diethyl-aceto-acetate		$CH_3CO \cdot C(C_2H_5)_2 \cdot CO_2C_2H_5$	186.14
11	diethyl-malonate		$(C_2H_5)_2 \cdot C \cdot (COO \cdot C_2H_5)_2$	216.16
12	dimethyl-malonate		$(CH_3)_2 \cdot C \cdot (COO \cdot C_2H_5)_2$	188.13
13	diphenylamine		$(C_6H_5)_2NC_2H_5$	197.13
14	diphenyl-phosphine		$(C_6H_5)_2C_2H_5P$	214.15
15	disulfide		$(C_2H_5)_2S_2$	122.21
16	fluoride		C_2H_5F	48.04
17	formamide		$HCONHC_2H_5$	73.06
18	formate		$HCOOC_2H_5$	74.05
19	glycerate		$C_2H_3(OH)_2COOC_2H_5$	134.08
20	glycine		$CH_2(NHC_2H_5)COOH$	103.08
21	glycol ether		$CH_3OH \cdot CH_2 \cdot O \cdot C_2H_5$	90.08
22	glycollate		$CH_2OH \cdot COOC_2H_5$	104.06
23	glycollic acid		$CH_2(OC_2H_5) \cdot COOF$	104.05
24	hexyl carbinol		$C_2H_5 \cdot CH(OH) \cdot C_6H_{13}$	144.16
25	hydrazine		$C_2H_5NH \cdot NH_2$	60.08
26	hydrocinnamate		$C_6H_5 \cdot CH_2 \cdot CH_2 \cdot COOC_2H_5$	178.11
27	hydrogenphthalate		$C_6H_4(COOC_2H_5) COOH$	194.08
28	hydrogen sulfate	ethyl sulfuric acid	$C_2H_5 \cdot HSO_4$	126.11
29	hydrosulphide.	See *ethyl mercaptan*		
30	hydroxylamine(α)		$NH_2 \cdot O \cdot C_2H_5$	61.06
31	" (β)		C_2H_5NHOH	61.06
32	iodide		C_2H_5I	155.97
33	isoamyl ether		$C_2H_5 \cdot O \cdot C_5H_{11}$	116.13
34	isobutyl		$CH_3(CH_2)_2CH(CH_3)_2$	86.11
35	isobutyl ether		$C_2H_5 \cdot O \cdot C_4H_9$	102.11
36	isobutyl ketone		$C_2H_5 \cdot CO \cdot C_4H_9$	114.11
37	isobutyrate		$(CH_3)_2CH \cdot COO \cdot C_2H_5$	116.10
38	isocyanate		C_2H_5NCO	71.05
39	isocyanide	ethyl carbylamine	C_2H_5NC	55.05
40	isopropyl-aceto-acetate		$C_2H_3O \cdot CH(C_3H_7) \cdot CO_2 \cdot C_2H_5$	172.13
41	isopropyl ether		$C_2H_5 \cdot O \cdot CH(CH_3)_2$	88.10
42	" ketone		$C_2H_5 \cdot CO \cdot CH(CH_3)_2$	100.10

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form and color	Sp. gr. $H_2O = 1$ (A)Air = 1	Melting-point °C	Boiling-point °C	Solubility in gms. per 100 c.c. of		
					Water	Alcohol	Ether
1	colorl. liq.	$0.921^{0°}$ ($0.925^{0°}$)	−141	12.2–.5	2	∞	∞
2	colorl. liq.	1.087	.....	146	v. sl. s.	∞	∞
3	colorl. liq.	1.050	12	271	i.	s.	v. s.
4	monocl.	.....	39.5 (41.5)	subl.	sl. s.	s.	.....
5	colorl. liq.	1.066	.....	207	i.	∞	∞
6	liq.	0.089	.....	162	i.	.....	.....
7	colorl. liq.	$0.780^{20°}$	.....	97.1	s.	∞	.....
8	colorl. liq.	1.101	.....	200–5	sl. s.	.....	.....
9	colorl. liq.	1.283	.....	156–8	v. sl. s.	∞	∞
10	colorl. liq.	$0.974^{20°}$	.....	218	i.	∞	∞
11	colorl. liq.	0.992	.....	223	i.	∞	∞
12	colorl. liq.	1.002	.....	196.5	i.	∞	∞
13	liq.	.....	.....	295	i.	s.	.....
14	liq.	.....	.....	293	.....	s.	s. bz.
15	.....	$0.993^{20°}$	.....	151	v. sl. s.	.....	.....
16	gas	1.7 A	.....	−32	198 c.c.$^{14°}$	v. s.	.....
17	.....	$0.952^{21°}$	.....	199	.....	.....	.....
18	liq.	0.917	−80	54.3	11	s.	s.
19	liq.	1.091	.....	230–40	s.	v. s.	v. s.
20	leaf.	.....	160 d.	.....	s.	s.	.....
21	colorl. liq.	$0.926^{13°}$	.....	135	s.	∞	∞
22	colorl. liq.	$1.083^{23°}$	.....	160	.....	v. s.	v. s.
23	liq.	.....	.....	206–7	.....	.....	.....
24	liq.	$0.839^{0°}$	.....	195^{750mm}	.....	.....	.....
25	colorl. liq.	.....	.....	101	v. s.	v. s.	v. s.
26	colorl. liq.	$1.102^{\frac{4}{25}}$	.....	247–9	i.	.....	.....
27	liq.	.....	.....	d.	sl. s.	s.	.....
28	liq.	1.316	.....	dec.	v. s.	s.	s.
29							
30	colorl. liq.	$0.883^{7.5°}$	.....	68	∞	∞	∞
31	colorl. leaf.	$0.908^{54°}$	59–60 d.	.....	v. s.	v. s.	sl. s.
32	liq.	$1.941^{15°}$	−112	72.3	$0.4^{20°}$	s.	s.
33	colorl. liq.	0.761	.....	112	i.	∞	∞
34	liq.	$0.7011^{0°}$	.....	62	.....	s.	s.
35	colorl. liq.	0.751	.....	78–80	i.	∞	∞
36	colorl. liq.	$0.815^{17°}$	.....	136	i.	∞	∞
37	colorl. liq.	$0.869^{20°}$	.....	110.1	sl. s.	∞	∞
38	liq.	0.898	.....	60	i.	.....	s.
39	colorl. liq.	$0.759^{4°}$	.....	78–9	v. s.	.....	s.
40	colorl. liq.	$0.947^{22°}$	.....	200.5 d.	v. sl. s.	∞	∞
41	colorl. liq.	$0.745^{0°}$	.....	54	s.	∞	∞
42	colorl. liq.	$0.830^{0°}$	.....	114.5	v. sl. s.	v. s.	∞

No.	Name	Synonyms	Formula	Mol. wt.
1	Ethyl-isosuccinate		$CH_3 \cdot CH(COO \cdot C_2H_5)_2$	174.11
2	isothiocyanate	ethyl mustard oil	$C_2H_5 \cdot N : CS$	87.11
3	isovaleriate		$(CH_3)_2CH \cdot CH_2 \cdot COO \cdot C_2H_5$	130.11
4	lactate		$C_3H_5O_3 \cdot C_2H_5$	118.08
5	malate		$C_2H_3(OH) \cdot (COO \cdot C_2H_5)_2$	190.11
6	malonic acid		$C_2H_5 \cdot CH(COOH)_2$	132.06
7	malonate		$CH_2(COO \cdot C_2H_5)_2$	160.10
8	mercaptan		C_2H_5SH	62.11
9	monotartrate		$COOH \cdot (CHOH)_2 \cdot COO \cdot C_2H_5$	178.08
10	mustard oil. See	*ethyl isothiocyanate*		
11	naphthalene (α)		$C_{10}H_7 \cdot C_2H_5$	156.10
12	" (β)		$C_{10}H_7 \cdot C_2H_5$	156.10
13	naphthyl ether (α)		$C_{10}H_7 \cdot O \cdot C_2H_5$	172.10
14	" " (β)		$C_{10}H_7 \cdot O \cdot C_2H_5$	172.10
15	naphthylamine		$C_{10}H_7NHC_2H_5$	171.11
16	nitrate		$C_2H_5NO_3$	91.05
17	nitrite		$C_2H_5NO_2$	75.05
18	nitro-benzoate (o.)		$NO_2 \cdot C_6H_4 \cdot COO \cdot C_2H_5$	195.08
19	" " (m.)		$NO_2 \cdot C_6H_4 \cdot COO \cdot C_2H_5$	195.08
20	" " (p.)		$NO_2 \cdot C_6H_4 \cdot COO \cdot C_2H_5$	195.08
21	nitrocinnamate (o.)		$C_9H_6(NO_2)O_2C_2H_5$	221.10
22	" (p.)		$C_9H_6(NO_2)O_2C_2H_5$	221.10
23	nitrolic acid		$CH_3C \cdot (NOH) \cdot NO_2$	104.05
24	oenanthylate		$CH_3 \cdot (CH_2)_5 COOC_2H_5$	158.14
25	orthoacetate		$CH_3 \cdot C(OC_2H_5)_3$	162.14
26	orthocarbonate		$C(OC_2H_5)_4$	192.16
27	orthoformate		$CH(OC_2H_5)_3$	148.13
28	orthosilicate		$(C_2H_5)_4SiO_4$	208.22
29	oxalacetate		$C_2H_5CO_2 \cdot CO \cdot CH_2 \cdot COOC_2H_5$	188.10
30	oxalate		$(\cdot COO \cdot C_2H_5)_2$	146.08
31	palmitate		$C_{15}H_{31} \cdot COO \cdot C_2H_5$	284.29
32	pelargonate		$C_9H_{18}O_2 \cdot C_2H_5$	187.18
33	phenate	See *phenetol*		
34	phenol (o.)		$C_2H_5 \cdot C_6H_4 \cdot OH$	122.08
35	" (p.)		$C_2H_5 \cdot C_6H_4 \cdot OH$	122.08
36	phenyl-acetate		$C_6H_5 \cdot CH_2 \cdot COO \cdot C_2H_5$	164.10
37	phenylacetylene		$C_6H_5C : CC_2H_5$	130.08
38	phenylcarbamate		$CO(NHC_6H_5)OC_2H_5$	165.10
39	phenylcarbinol		$C_6H_5 \cdot CH(OH) \cdot C_2H_5$	136.10
40	phenylhydrazine (α, α)		$C_6H_5N(C_2H_5) \cdot NH_2$	136.11
41	" (α, β)		$C_6H_5NH \cdot NHC_2H_5$	136.11

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form and color	Sp. gr. $H_2O = 1$ (A) Air = 1	Melting-point °C	Boiling-point °C	Solubility in gms. per 100 c.c. of		
					Water	Alcohol	Ether
1	colorl. liq.	1.021	.....	198	v. sl. s.	∞	∞
2	colorl. liq.	$0.995^{23°}$	−5.9	131–2	i.	s.	s.
3	colorl. liq.	0.872	.....	134.3	i.	∞	∞
4	colorl. liq.	$1.031^{19°}$	.....	154.5	∞	v. s.	v. s.
5	colorl. liq.	$1.124^{\frac{25°}{25°}}$	.....	248–52 d.	s.	∞	∞
6	rhomb.	.....	111.5	160 d.	s.	s.	s.
7	colorl. liq.	1.061	−50	198	v. sl. s.	∞	∞
8	liq.	0.838^{21}	−144	36–7	1.5	s.	s.
9	colorl. rhomb.	.....	90	.....	s.	.....	.....
10							
11	colorl. liq.	$1.064^{\frac{15°}{4°}}$	.....	258 sl. d.	i.	∞	∞
12	colorl. liq.	$1.008^{0°}$	−19	251	i.	∞	∞
13	liq.	.....	5.5	280	i.	v. s.	v. s.
14	.....	.....	37	282	i.	sl. s.	s.
15	cryst.	.....	193	303	.....	.....	.....
16	colorl. liq.	1.116	−112	87.6	i.	∞	∞
17	liq.	0.900	.....	17	v. sl. s.	∞	s.
18	colorl. tricl.	.....	30	.....	.....	.....	.....
19	prisms	.....	47 (54)	.....	i.	v. s.	v. s.
20	colorl.	.....	57	.....	.....	.....	.....
21	rhomb. need.	.....	44	.....	v. s. bz.	v. s.	v. s.
22	yel. need.	.....	140–1	.....	i.	sl. s.	sl. s.
23	yel. rhomb.	.....	86–8 d.	.....	s.	.....	s.
24	liq.	.....	.....	188	.....	.....	.....
25	.....	$0.94^{22°}$	.....	142	.....	.....	.....
26	liq.	.....	.....	158–9	.....	.....	.....
27	liq.	.....	.....	146	.....	.....	.....
28	.....	$0.933^{20°}$	.....	165	d.	.....	.....
29	.....	.....	.....	131	.....	.....	.....
30	colorl. liq.	1.085	.....	186.1	sl. s.	∞	∞
31	colorl.	.....	24.2	.....	i.	s.	s.
32	liq.	.....	.....	.....	.....	s.	.....
33							
34	colorl. liq.	$1.037^{0°}$	.....	206.5–7.5	.....	.....	.....
35	colorl.	.....	46	218.5	.....	v. s.	v. s.
36	colorl. liq.	1.086	.....	229 (226)	i.	∞	∞
37	.....	$0.923^{21°}$	.....	202	.....	.....	.....
38	lng. need. f. w.	.....	52	237–8	.....	.....	.....
39	liq.	$0.99^{15°}$	.....	212	.....	s.	s.
40	liq.	$1.018^{15°}$	.....	237	.....	.....	.....
41	liq.	1. + −	.....	100–4 ^{10mm}	sl. s.	s.	s.

No.	Name	Synonyms	Formula	Mol. wt.
	Ethyl-			
1	phenyl ketone		$C_2H_5 \cdot CO \cdot C_6H_5$	134.08
2	phenylsulfone		$C_6H_5 \cdot SO_2 \cdot C_2H_5$	170.14
3	phenylurea		$C_2H_5 \cdot NH \cdot CO \cdot NH \cdot C_6H_5$	164.11
4	phosphate		$(C_2H_5)_3PO_4$	182.15
5	phosphine		$C_2H_5 \cdot PH_2$	62.08
6	phthalate (o.)		$C_6H_4 \cdot (COO \cdot C_2H_5)_2$	222.11
7	" (m.)	ethyl isophthalate	$C_6H_4 \cdot (COO \cdot C_2H_5)_2$	222.11
8	" (p.)	ethyl terephthalate	$C_6H_4 \cdot (COO \cdot C_2H_5)_2$	222.11
9	propiolate		$CH \equiv C \cdot COO \cdot C_2H_5$	98.05
10	propionate		$C_2H_5 \cdot COO \cdot C_2H_5$	102.08
11	propyl carbinol (n.)		$C_3H_7 \cdot CHOH \cdot C_2H_5$	102.11
12	" ether		$C_3H_7 \cdot O \cdot C_2H_5$	88.10
13	" ketone		$C_2H_5COC_3H_7$	100.10
14	" malonate		$C_3H_7 \cdot CH \cdot (COO \cdot C_2H_5)_2$	202.14
15	pyridine (2)		$C_2H_5 \cdot C_5H_4N$	107.08
16	" (3)		$C_2H_5 \cdot C_5H_4N$	107.08
17	" (4)		$C_2H_5 \cdot C_5H_4N$	107.08
18	salicylate		$HO \cdot C_6H_4 \cdot COO \cdot C_2H_5$	166.08
19	silicate	See *ethyl orthosilicate*		
20	succinate (n.)		$(\cdot CH_2 \cdot COO \cdot C_2H_5)_2$	174.11
21	succinic acid		$C_2H_3(C_2H_5)(COOH)_2$	146.08
22	sulfate		$(C_2H_5)_2SO_4$	154.14
23	sulfide		$(C_2H_5)_2S$	90.14
24	sulfinic acid		$C_2H_5 \cdot SO_2H$	94.11
25	sulfite		$(C_2H_5)_2SO_3$	138.14
26	sulfocyanate	See *ethyl thiocyanate*		
27	sulfone		$(C_2H_5)_2SO_2$	122.14
28	sulfonic acid		$C_2H_5SO_2 \cdot OH$	110.11
29	sulfonic chloride		$C_2H_5 \cdot SO_2Cl$	128.56
30	sulfoxide		$(C_2H_5)_2SO$	106.14
31	tartrate (d. or l.)		$[\cdot CH(OH) \cdot COO \cdot C_2H_5]_2$	206.11
32	thiocarbamate		$CS(NH_2)SC_2H_5$	121.19
33	thiocyanate		$C_2H_5 \cdot SCN$	87.11
34	toluate (o.)		$CH_3 \cdot C_6H_4 \cdot COO \cdot C_2H_5$	164.10
35	" (m.)		$CH_3 \cdot C_6H_4 \cdot COO \cdot C_2H_5$	164.10
36	" (p.)		$CH_3 \cdot C_6H_4 \cdot COO \cdot C_2H_5$	164.10
37	toluene (o.)	methylethyl benzene (o.)	$C_2H_5 \cdot C_6H_4 \cdot CH_3$	120.10
38	" (m.)	methylethyl benzene (m.)	$C_2H_5 \cdot C_6H_4 \cdot CH_3$	120.10
39	" (p.)	methylethyl benzene (p.)	$C_2H_5 \cdot C_6H_4 \cdot CH_3$	120.10
40	trichloracetate		$CCl_3 \cdot COO \cdot C_2H_5$	191.41
41	urea		$NH_2 \cdot CO \cdot NHC_2H_5$	88.08
42	valeriate		$C_4H_9 \cdot COO \cdot C_2H_5$	130.11

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form and color	Sp. gr. $H_2O = 1$ (A) Air = 1	Melting-point °C	Boiling-point °C	Solubility in gms. per 100 c.c. of		
					Water	Alcohol	Ether
1	color. leaf	1.015	21	218	i.	s.	s.
2	monocl.	.....	42	>300	sl. s. c.	s.	s.
3	need.	.....	9.9	.....	.....	s.	.....
4	.....	.....	.....	215	d.	s.	s.
5	liq.	$<H_2O$	.....	25	.....	.....	.....
6	colorl. liq.	$1.118^{20°}$	.....	295	i.	∞	∞
7	colorl. liq.	.....	.....	285	.....	.....	.....
8	colorl.	.....	44	.....	.....	.....	.....
9	colorl. liq.	.....	.....	119	i.	v. s.	v. s.
10	colorl. liq.	0.896	.....	98.3	$2.4^{20°}$	∞	∞
11	colorl. liq.	$0.819^{20°}$	.....	135	.....	s.	.....
12	colorl. liq.	$0.755^{0°}$	.....	63.6	s.	∞	∞
13	colorl. liq.	$0.818^{18°}$	.....	122–4	v. sl. s.	∞	∞
14	colorl. liq.	0.993	.....	221	.....	.....	.....
15	liq.	$0.937^{17°}$	.....	148.6	sl. s.	∞	v. s.
16	colorl. liq.	$0.959^{0°}$	.....	165	v. sl. s.	.....	.....
17	colorl. liq.	$0.952^{0°}$	.....	164–6	s. dil. a.	.....	.....
18	colorl. liq.	1.135	1.3	231	.....	∞	∞
19							
20	colorl. liq.	1.044	−20.8	216.5	i.	∞	∞
21	colorl. prisms	.....	98	.....	v. s.	v. s.	v. s.
22	colorl. liq.	1.184	−24.5	208	i.; sl. dec.	dec. h.	.....
23	colorl. liq.	$0.837^{20°}$	−99.5	91–3	i.	s.	s.
24	syrup...	.....	.....	.....	.....	.....	s. alk.
25	colorl. liq.	$1.106^{0°}$	.....	161	s. dec.	s.	.....
26							
27	rhombic	$1.357^{20°}$	70	248	$15.6^{15°}$	.....	.....
28	crystals	.....	.....	.....	s.	s.	s. alk.
29	liq.	.....	.....	177	dec.	dec.	v. s.
30	liq.	.....	.....	.....	s.	.....	.....
31	colorl. liq.	1.209	.....	280	sl. s.	∞	∞
32	.....	.....	41–2	.....	v. sl. s.	s.	s.
33	colorl. liq.	$1.007^{23°}$	.....	146 (142)	i.	∞	∞
34	colorl. liq.	1.039	.....	221 (227)	i.	∞	∞
35	colorl. liq.	.....	.....	226–8	i.	∞	∞
36	colorl. liq.	.....	.....	228	.....	.....	.....
37	colorl. liq.	0.873	.....	158–9	i.	∞	∞
38	colorl. liq.	$0.869^{20°}$	.....	158–9	i.	s.	s.
39	colorl. liq.	$0.865^{21°}$	.....	162	i.	s.	s.
40	colorl. liq.	1.369	.....	164–7	i.	∞	∞
41	colorl. prisms	$1.213^{18°}$	92	.....	v. s.	v. s.	i.
42	colorl. liq.	$0.877^{20°}$	.....	144.5	i.	∞	∞

No.	Name	Synonyms	Formula	Mol. wt.
1	Ethyl-vanillate		$C_{10}H_{12}O_4$	196.10
2	xylene 1, 3, 5		$C_6H_3(CH_3)_2C_2H_5$	134.11
3	" 1, 3, 4		$C_6H_3(CH_3)_2C_2H_5$	134.11
4	Ethylene		$CH_2:CH_2$	28.03
5	acetate		$(CH_3\cdot COO)_2C_2H_4$	146.08
6	alcohol	See *ethylene glycol*		
7	benzoate		$C_2H_4(C_7H_5O_2)_2$	270.11
8	bromide	glycol dibromide	$CH_2Br\cdot CH_2Br$	187.86
9	chlorohydrine		$CH_2Cl\cdot CH_2OH$	80.50
10	chloride	glycol dichloride	$CH_2Cl\cdot CH_2Cl$	98.95
11	cyanhydrine	glycol cyanhydrine	$HO\cdot CH_2\cdot CH_2\cdot CN$	71.05
12	cyanide	succinonitrile	$CN\cdot CH_2\cdot CH_2\cdot CN$	80.05
13	diamine		$NH_2\cdot CH_2\cdot CH_2NH_2$	60.08
14	diphenyldiamine		$C_2H_4(C_6H_5\cdot NH)_2$	212.14
15	diphenyl ether		$C_2H_4(OC_6H_5)_2$	214.11
16	disulfonic acid		$C_2H_4(SO_3H)_2$	190.18
17	ethylidene oxide		$CH_3\cdot CHO_2C_2H_4$	88.06
18	glycol	glycol	$HOCH_2\cdot CH_2OH$	62.05
19	glycol monoacetate		$HOCH_2\cdot CH_2OOC\cdot CH_3$	104.06
20	iodide	glycol diiodide	$CH_2I\cdot CH_2I$	281.90
21	lactic acid	See *hydracrylic acid*		
22	mercaptan		$C_2H_4(SH)_2$	94.18
23	nitrate	glycol dinitrate	$NO_3\cdot CH_2\cdot CH_2\cdot NO_3$	152.05
24	nitrite	glycol dinitrite	$NO_2\cdot CH_2\cdot CH_2\cdot NO_2$	120.05
25	oxide		C_2H_4O	44.03
26	phenylsulfone		$(C_6H_5SO_2)_2C_2H_4$	310.24
27	thiocyanate		$C_2H_4(SCN)_2$	144.18
28	urea		$CH_2\cdot NHCONHCH_2$	86.06
29	Ethylidene acetone		$CH_3COCH:CH\cdot CH_3$	84.06
30	cyanhydrine		$CH_3CH(OH)CN$	71.05
31	dibromide		$CH_3\cdot CHBr_2$	187.86
32	dichloride		$CH_3\cdot CHCl_2$	98.95
33	diiodide		$CH_3\cdot CHI_2$	281.90
34	urea		$C_3H_6ON_2$	86.06
35	urethane		$C_2H_4(NHCOOC_2H_5)_2$	204.14
36	Eucalyptol	cineol	$C_{10}H_{18}O$	154.14
37	Eugenol (1, 4, 3)	eugenic acid	$C_3H_5\cdot C_6H_3(OH)(OCH_3)$	164.10
38	methyl ether (1, 2, 4)		$C_3H_5\cdot C_6H_3:(OCH_3)_2$	178.11
39	Eugetinic acid		$C_8H_2(OH)(OCH_3)C_3H_5COOH$	208.09
40	Eupittonic acid		$C_{19}H_8(OCH_3)_6O_2$	470.21
41	Euxanthic acid		$C_{19}H_{16}O_{10} + 3H_2O$	458.18

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form and color	Sp. gr. $H_2O = 1$ (A)Air = 1	Melting-point °C	Boiling-point °C	Solubility in gms. per 100 c.c. of		
					Water	Alcohol	Ether
1	colorl.	.....	44	292	i.	v. s.	v. s.
2	liq.	$0.861^{20°}$	.....	185	i.	.....	s.
3	liq.	$0.8783^{20°}$	.....	183–4	.....	.....	.....
4	gas	0.978(A)	−169	−102.7	25.6 c.c.$^{0°}$	360 c.c.	s.
5	colorl. liq.	$1.128^{0°}$	.....	186–7	14.3	s.	s.
6							
7	rhomb.pr.	.....	67	>360	i.	.....	s.
8	colorl. liq.	2.189	9–10	131	v. sl. s.	s.	∞
9	colorl. liq.	$1.213^{15°}_{4}$	69	128**	s.	s.	s.
10	colorl. liq.	1.265^{4}	.....	84	sl. s.	s.	∞
11	colorl. liq.	$1.059^{0°}$	.....	221–3	∞	∞	s.
12	colorl.	.....	51–2 (54.5)	265–7 d.	v. s.	v. s.	s.
13	colorl.	0.902	10 ($1H_2O$)	117	s.	.....	v. sl. s.
14	cryst.	.....	59.(63)	.....	i.	s.	s.
15	colorl.	.....	98.5	.....	v. sl. s. c.	sl. s.	v. s.
16	.....	.....	94	.....	deliq.	s.	.....
17	.....	1.0002	.....	82.5	1 : 1.5	.....	.....
18	colorl. liq.	1.115	.....	197–7.5	∞	∞	sl. s.
19	colorl. liq.	1.108	.....	182	∞	s.	.....
20	yel. pr.	2.07	81.2	.....	sl. s.	s.	s.
21							
22	liq.	$1.123^{23°}$	.....	146	.....	s.	s. NH_3 aq.
23	yel. liq.	$1.483^{8°}$	.....	*	i.	s.	.....
24	liq.	$1.216^{0°}$	.....	96–8	i.	s.	s.
25	colorl. liq.	$0.897^{0°}$	.....	14	∞	∞	∞
26	need.	.....	180	.....	sl. s. h.	sl. s. h.	s. glac. acet. a.; s. bz.
27	rhombic	.....	90	d.	s.	s.	.....
28	need.	.....	131	.....	s. chl.	.....	.....
29	liq.	0.861	.....	122	.....	.....	.....
30	.....	.....	.....	182–4	s.	s.	s.
31	liq.	2.100	.....	110–12.5	i.	v. s.	v. s.
32	colorl. liq.	1.178	.....	58–60	$0.55^{20°}$	v. s.	v. s.
33	liq.	$2.84^{0°}$	.....	178	i.	v. s.	v. s.
34	colorl. need.	.....	154	d.	v. sl. s.	sl. s.	v. sl. s.
36	need.	.....	125–6	d.	sl. s. c.	s.	s.
36	colorl. liq.	$0.927^{20°}$	−1—3	176	i.	∞	∞
37	colorl. liq.	$1.063^{18°}$	.....	247.5 (253)	v. sl. s.	∞	∞
38	colorl. liq.	$1.035^{25°}_{25°}$	.....	250–3 (244)	i.	∞	∞
39	pr.	.....	124	.....	sl. s. c.	s.	s.
40	or. need.	.....	200 d.	.....	bl. in alk.	sl. s. h.	s. glac. acet. a.
41	yel. need.	.....	160 d.	.....	sl. s.	s. h.	v. s.

* Explodes by percussion or on heating to 114–16° C.
** Constant boiling mixture, 42.5% H_2O — boiling point 95.8°.

No.	Name	Synonyms	Formula	Mol. wt.
1	Euxanthone	1, 7-dihydroxyxanthone	$HO \cdot C_6H_3CO_2C_6H_3OH$	228.06
2	Evernic acid		$C_{17}H_{16}O_7$	332.13
3	Everninic acid		$C_8H_7(OH)_2COOH$	182.08
4	Fenchene		$C_{10}H_{16}$	136.13
5	Fenchone		$C_{10}H_{16}O$	152.13
6	Ferulic acid		$C_6H_3(OCH_3)OH \cdot C_2H_2COOH$	194.08
7	Fisetin	tetrahydroxyflavone	$HOC_6H_3OC(C_6H_3(OH)_2)C(OH)CO$	286.08
8	Fixilic acid		$C_{14}H_{18}O_5$	266.14
9	Flavaniline		$NH_2 \cdot C_6H_4 \cdot C_9H_5N \cdot CH_3$	234.13
10	Flavone	β-phenylbenzo-γ-pyrone	$C_6H_4OC(C_6H_5):CHCO$	222.08
11	Flavopurpurin	trihydroxy-anthraquinone (1, 2, 6)	$C_{14}H_5O_2 \cdot (OH)_3$	256.06
12	Fluoran		$C_{20}H_{12}O_3$	300.10
13	Fluoranthene		$C_{15}H_{10}$	190.08
14	Fluorene		$(C_6H_4)_2 : CH_2$	166.08
15	Fluorene alcohol		$(C_6H_4)_2CHOH$	182.08
16	Fluorenenone	diphenylene ketone	$(C_6H_4)_2CO$	180.06
17	Fluorbenzene		C_6H_5F	96.04
18	Fluorbenzoic acid (o.)		C_6H_4FCOOH	140.04
19	" " (m.)		C_6H_4FCOOH	140.04
20	" " (p.)		C_6H_4FCOOH	140.04
21	Fluorescein		$C_{20}H_{12}O_5$	332.10
22	Fluoroform		CHF_3	70.01
23	Formaldehyde		$HCHO$	30.02
24	Formamide		$HCONH_2$	45.03
25	Formamidoxime	isuretin	$CH(NH_2) : NOH$	60.05
26	Formanilid		C_6H_5NHOCH	121.06
27	Formic acid		$HCOOH$	46.02
28	Formoxime		$CH_2 : NOH$	45.03
29	Formyldiphenylamine		$CHON(C_6H_5)_2$	197.10
30	Formylhydrazine		$HCONH \cdot NH_2$	60.05
31	Formylsulfaldehyde		$C_3H_6S_3$	138.24
32	Frangulin		$C_{20}H_{20}O_9$	404.16
33	Fraxin		$C_{32}H_{36}O_{20}$	740.29
34	Fructose	laevulose, fruit sugar	$C_6H_{12}O_6$	180.10
35	Fuchsin	See *rosaniline*		
36	Fulminuric acid		$C_3H_3O_3N_3$	129.05
37	Fumaric acid		$HOOC \cdot CH : CH \cdot COOH$	116.03
38	Furfural	furfuraldehyde	$C_4H_3O \cdot CHO$	96.03
39	Furfuramide		$(C_5H_4O)_3N_2$	268.11
40	Furfurane		C_4H_4O	68.03

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form and color	Sp. gr. $H_2O = 1$ (A)Air = 1	Melting-point °C	Boiling-point °C	Solubility in gms. per 100 c.c. of		
					Water	Alcohol	Ether
1	yel. need.	.....	240	.....	i.	s. h.	sl. s.; s. alk.
2	need.	.....	164	.....	i. c.	s.	s.
3	cryst.	.....	157	.....	s.$^{100°}$	s.	s.
4	.....	0.864$^{20°}$	.....	158–60	.....	.....	.....
5	cryst.	0.9465$^{19°}$	5–6	192–3	.....	.....	.....
6	rhomb. need.	.....	168	d.	s. h.	v. s.	sl. s.
7	.....	.....	.....	.....	.....	s.	.....
8	cryst.	.....	160	.....	i.	i.	sl. s.
9	colorl. pr.	.....	97	.....	v. sl. s.	v. s.	s. bz.
10	.....	.....	97	.....	.....	.....	.....
11	yel. need.	.....	459	.....	v. sl. s. h.	s. h.	sl. s.
12	need.	.....	180 (175)	.....	.....	s.	.....
13	colorl. monocl.	.....	109–10	.....	.....	sl. s. c.	v. s.
14	colorl. leaf.	.....	113–6	295	.....	sl. s.	v. s.
15	hex.	.....	153	.....	.....	s.	s.
16	yel. rhomb. pl.	.....	84	341	i.	s.	s.
17	.....	1.0236$^{20°}$	40	180–3	.....	.....	.....
18	need. f. w.	.....	123	.....	sl. s.	v. s.	v. s.
19	leaf. f. w.	.....	123.6	.....	.....	.....	.....
20	monoclpr.	.....	182	.....	sl. s.	s.	s.
21	or. powd.	.....	d. 290	.....	i.; s. alk.	s.	s.
22	gas	.....	.....	20$^{40 atm.}$	sl. s.	500 c. c.	s. l. s. chl
23	colorl. gas	.....	.....	−21	s.	s.	s.
24	colorl. liq.	1.337	.....	192–5 d.	∞	∞	sl. s.
25	rhomb.	.....	114	d.	s.	v. s.	s.
26	colorl. pr.	1.144	46	.....	s.	v. s	s.
27	colorl. liq.	1.218$^{20°}$	8.6	100.8	∞	∞	.....
28	.....	.....	.....	84	d. h.	.....	.....
29	cryst.	.....	73–4	210–20 vac.	.....	s.	.....
30	.....	.....	54	.....	.....	.....	.....
31	tetr. pr.	.....	218	subl.	sl. s. h.	sl. s.	sl. s.
32	yel. cryst.	.....	286	.....	v. sl. s.	s. h.	s. h.
33	need.	.....	190	.....	s. h.	s.	.....
34	need. f. w.	1.555$^{0°}$	94–5	.....	v. s.	20	s.
35							
36	colorl. prisms	.....	exp. 145	.....	s.	s.	s.
37	colorl. prisms	1.625	284	sub. 200	0.70$^{25°}$ 9.8$^{100°}$	5.75$^{29.7°}$ v.sl.s. CCl$_4$	0.72$^{25°}$ or CHCl$_3$
38	colorl–yel.	1.159$^{20°}$	−36.5	161	9$^{13°}$	s.	s.
39	need.	.....	.....	250 d.	i.	s.	s.
40	colorl. need.	0.944	.....	31.5	i.	v. s.	v. s.

No.	Name	Synonyms	Formula	Mol. wt.
1	Furfuryl alcohol		$C_4H_3O \cdot CH_2OH$	98.05
2	Furfuryl amine		$C_4H_3O \cdot CH_2 \cdot NH_2$	97.06
3	Galactose (d.)		$C_6H_{12}O_6$	180.10
4	Gallein		$C_{20}H_{10}O_7$	362.08
5	Gallic acid (3, 4, 5)		$(HO)_3C_6H_2COOH + H_2O$	188.06
6	Gallin		$C_{20}H_{14}O_7$	366.11
7	Gentianin	gentisin	$C_{14}H_{10}O_5$	258.08
8	Geraniol		$C_9H_{15} \cdot CH_2OH$	154.14
9	acetate		$CH_3 \cdot COOC_{10}H_{17}$	196.16
10	Gluconic acid		$C_5H_6(OH)_5COOH$	196.10
11	Glucosazone (d.)		$C_6H_{10}O_4(N_2HC_6H_5)_2$	358.21
12	Glucose (d.)	See *dextrose*		
13	pentacetate		$C_6H_7O_6(COCH_3)_5$	390.18
14	phenyl hydrazone (α)		$C_6H_{12}O_5N_2HC_6H_5$	270.16
15	phenyl hydrazone (β)		$C_6H_{12}O_5N_2HC_6H_5$	270.16
16	Glucosone		$C_4H_9O_4CO \cdot CHO$	178.08
17	Glucosoxime (d.)		$C_6H_{12}O_5 : NOH$	195.11
18	Glutamic acid (r.)	glutaminic acid	$C_3H_5(NH_2)(COOH)_2$	147.08
19	Glutamine		$C_3H_5(NH_2)(CONH_2)COOH$	146.10
20	Glutaric acid		$HOOC \cdot (CH_2)_3 \cdot COOH$	132.06
21	Glyceric acid		$HOCH_2 \cdot CHOH \cdot COOH$	106.05
22	aldehyde		$HOCH_2 \cdot CHOH \cdot CHO$	90.05
23	Glycerine		$HOCH_2 \cdot CHOH \cdot CH_2OH$	92.06
24	Glycerolphosphoric acid		$C_3H_5(OH)_2OPO_3H$	171.09
25	Glyceryl			
26	chlorhydrine (α)	See *chlorhydrine* α		
27	diacetate	See *diacetin*		
28	dichlorhydrine (α, α)	See *dichlorhydrine* (1, 3)		
29	" (α, β)	See *dichlorhydrine* (2, 3)		
30	dinitrate (α)		$C_3H_5(OH)(NO_3)_2 + \frac{1}{3}H_2O$	188.07
31	ether		$C_3H_5O_3C_3H_5$	130.08
32	monoacetate	See *monacetin*		
33	mononitrate (α)		$CH_2OH \cdot CHOH \cdot CH_2NO_3$	137.06
34	triacetate	See *triacetin*		
35	tribromhydrine	See *tribromhydrine*		
36	trichlorhydrine	See *trichlorhydrine*		
37	trinitrate	See *nitroglycerine*		
38	trinitrite		$CH_2NO_2 \cdot CHNO_2 \cdot CH_2NO_2$	179.06
39	Glycid		$C_2H_3O \cdot CH_2OH$	74.05

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form and color	Sp. gr. $H_2O = 1$ (A)Air = 1	Melting-point °C.	Boiling-point °C	Solubility in gms. per 100 c.c. of		
					Water	Alcohol	Ether
1	colorl. liq.	$1.136^{20°}$	.....	168–70	s.	v. s.	v. s.
2	liq.	$<H_2O$	.....	145–6	s.	.....	.....
3	hex. tab.	.....	168–70	.....	v. s.	sl. s.	.....
4	red. cryst.	.....	d.	.....	v. sl. s. h.	s.	sl. s.; s. alk.
5	tricl.	$1.694^{4°}$	222–40	d.	$1.16^{25°}$	$27.2^{25°}$	$2.5^{15°}$
6	need.	.....	.....	.....	s.	s.	s.
7	yel. need.	.....	.....	250 subl. d.	v. sl. s.	sl. s. h.	sl. s. hs.
8	colorl. liq.	0.881	.....	229–30	i.	∞	∞
9	colorl. liq.	0.915	.....	242–5 d.	v. sl. s.	v. s.	∞
0	syrup	.....	.....	.....	sl. s.	i.	.....
1	.....	.....	145; β 204	.....	v. sl. s.	sl. s.	.....
2							
3	need.	.....	130	subl.	v. sl. s.	$1.32^{15°}$	$2.1^{15°}$
4	.....	.....	144–5	.....	v. s.	v. s. h.	v. sl. s.
5	need.	.....	115–6	.....	.....	s.	.....
6	.....	.....	.....	.....	s.	.....	.....
7	.....	.....	137.5	.....	.....	.....	.....
8	colorl.	.....	208 d.	.....	1	v. sl. s.	.....
9	need.	.....	.....	.....	.....	1 : 25	i.
0	colorl. monocl.	.....	97.5	302–4 d.	$64^{20°}$	v. s.	v. s.
	syrup	.....	.....	.....	∞	∞	i.; v. s. acet.
2	.....	.....	abt. 132	.....	sl. s.	v. sl. s.	v. sl. s.
3	colorl. liq.	$1.260^{20°}$	17*	290	∞	∞	i.
	.....	.....	d.	.....	s. h. d.	s.	.....
	.....	1.47 anh.	26	.....	7.7	v. s.	s.
	colorl. liq.	1.091	.....	171–2	∞	∞	∞
	.....	1.40	5.8	.....	$70^{15°}$	v. s.	sl. s.
	yel. liq.	.....	.....	150	i.	dec.	s.
	colorl.	1.165°°	.....	161–2d.	∞	∞	∞

* Solidifies at a much lower temperature.

No.	Name	Synonyms	Formula	Mol. wt.
1	Glycin	glycocoll	$CH_2(NH_2)\cdot COOH$	75.0
2	Glycocoholic acid		$C_{24}H_{39}O_4\cdot NH\cdot CH_2\cdot COOH$	465.3
3	Glycogen		$(C_6H_{10}O_5)x$	162.08
4	Glycol	ethylene glycol	$HOCH_2\cdot CH_2OH$	62.0
5	acetate		$C_2H_4(OH)OC_2H_3O$	104.0
6	aldehyde		$CH_2OH\cdot CHO$	60.0
7	amide		$CH_2(OH)\cdot CONH_2$	75.0
8	bromhydrine	ethylene bromhydrine	$CH_2OH\cdot CH_2Br$	124.9
9	chlorhydrine	ethylene chlorhydrine	$CH_2OH\cdot CH_2Cl$	80.5
10	cyanhydride	ethylene cyanhydride	$CH_2OH\cdot CH_2CN$	71.0
11	diacetate	See *ethylene acetate*		
12	dibromide.	See *ethylene bromide*		
13	dichloride.	See *ethylene chloride*		
14	dicyanide.	See *ethylene cyanide*		
15	diiodide.	See *ethylene iodide*		
16	dinitrate.	See *ethylene nitrate*		
17	dinitrite.	See *ethylene nitrite*		
18	monoacetate.	See *ethylene glycol*	*monoacetate*	
19	urea	hydantoin	$C_3H_4O_2N_2$	100.0
20	Glycolid		$C_4H_4O_4$	116.0
21	Glycollic acid	hydroxyacetic acid	$CH_2(OH)\cdot COOH$	76.0
22	anhydride		$C_4H_6O_5$	134.0
23	Glycocyamine		$C(NH)(NH_2)NHCH_2COOH$	117.0
24	Glycolylthiourea		$C_3H_4N_2SO$	116.1
25	Glyoxal	oxalaldehyde	$CHO\cdot CHO$	58.0
26	Glyoxalic acid	glyoxylic acid	$CHO\cdot COOH + H_2O$	92.0
27	Glyoxalin		$C_3H_4N_2$	68.0
28	Glyoxime		$HON:CH\cdot CH:NOH$	88.0
29	Guaiacol		$HO\cdot C_6H_4\cdot OCH_3(o)$	124.0
30	Guanidine		$NH:C(NH_2)_2$	59.0
31	Guanine		$C_5H_5ON_5$	151.0
32	Gun cotton. See	*cellulose hexanitrate*		
33	Haematein		$C_{16}H_{12}O_6$	300.1
34	Haematin		$C_{32}H_{32}N_4Fe_4$	695.6
35	Haematoxylin		$C_{16}H_{14}O_6 + 3H_2O$	356.1
36	Harmalin		$C_{13}H_{14}N_2O$	214.1
37	Harmin		$C_{13}H_{12}N_2O$	212.1
38	Helenin		$C_{12}H_{16}O_2$	192.1
39	Helicin		$C_{13}H_{16}O_7(\frac{1}{2}H_2O?)$	299.6

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form and color	Sp. gr. $H_2O = 1$ (A)Air = 1	Melting-point °C	Boiling-point °C	Solubility in gms. per 100 c.c. of		
					Water	Alcohol	Ether
1	colorl. monocl.	1.161	231–5 d.	.....	23 c.	v. sl. s.	i.
2	colorl. need.	.....	132–4 (152)	.....	0.33 c.	v. s.	v. sl. s.
3	wh. amor.	.....	abt. 240	.....	v. s.	i.	i.
4	colorl. liq.	1.115	.....	197–7.5	∞	∞	sl. s.
5	liq.	$<H_2O$	.....	182	∞	∞	.....
6	plates	.....	95–7	.....	v. s.	v. s. h.	sl. s.
7	colorl.	.....	120	.....	v. s.	sl. s.	sl. s.
8	liq.	.....	.....	147	s.	.....	.....
9	colorl. liq.	$1.223^{0°}$	.....	128	∞	.....	.....
0	colorl. liq.	$1.059^{0°}$	.....	221–3	∞	∞	s.
1							
2							
3							
4							
5							
6							
7							
8							
9	colorl. need.	.....	215	.....	s.; v. s. h.	.....	.....
0	colorl. leaf.	.....	86–7	.....	i.; v. s. acet.	sl. s.	sl. s.
1	leaf. f. eth.	.....	78–9	dec.	s.	s.	s.
2	powd.	.....	128–30	.....	i.; c. s. h.	i.	i.
3	leaf.	.....	.....	.....	sh.	i.	i.
4	need. f. h. w.	.....	d. 200	.....	s. h.	i.	i.
5	.....	1.14	15	50.5	v. s.	s.	s
6	colorl. rhomb.	.....	.....	.....	v. s.	.....	.....
	colorl. prisms	.....	88–9	255	v. s.	v. s.	s.
8	rhomb. tab. f. w.	.....	178	.....	v. s. h.	s.	s.
9	colorl. prisms	$1.140^{15°}_{15°}$	31–2	205	$1.6^{15°}$	s.	s.
	cryst.	.....	.....	.....	v. s.	v. s.	.....
	colorl. need.	.....	dec. abv. 360	.....	i.; s. alk.	v. sl. s.	v. sl. s.
	brown plates	.....	.....	.....	$0.6^{20°}$	sl. s.	sl. s. sl. s.
	brown powd.	.....	.....	.....	s. alk.	s. h.	.....
	tetrag.	.....	140	.....	v. sl. s.	s.	s.
	rhomb. f. al.	.....	.....	.....	v. sl. s.	sl. s.	sl. s.
	monocl. f. al.	.....	.....	256 subl.	v. sl. s.	sl. s.	sl. s.
	need.	.....	109–11	.....	sl. s.	s.	.....
	.....	.....	175	.....	v. s. h.	s.	i.

No.	Name	Synonyms	Formula	Mol. wt.
1	Hemimelitic acid.	benzenetricarboxylic acid (1, 2, 3)	$C_6H_3(COOH)_3$	210.05
2	Hemimellithene..	See *trimethylbenzene* (1, 2, 3)	C_9H_{12}	120.10
3	Hemipinic acid (3, 4) (1, 2)	.....	$C_6H_2(OCH_3)_2(COOH)_2$	226.08
4	Heptamethylene .	.....	C_7H_{14}	98.11
5	Heptane (n.).....	.....	$CH_3 \cdot (CH_2)_5CH_3$	100.13
6	Heptoic acid (n.).	oenanthylic acid..	$CH_3 \cdot (CH_2)_5 \cdot COOH$	130.11
7	Heptoic anhydride	.....	$(C_6H_{13}CO)_2O$	242.21
8	Heptyl acetate (n.)	.....	$CH_3 \cdot COOC_7H_{15}$	158.14
9	alcohol.....	.....	$CH_3 \cdot (CH_2)_5 \cdot CH_2OH$	116.13
10	aldehyde.....	oenanthal.....	$CH_3 \cdot (CH_2)_5 \cdot CHO$..	114.11
11	amine.....	.....	$CH_3 \cdot (CH_2)_5 \cdot CH_2NH_2$	116.14
12	ether.....	.....	$(C_7H_{15})_2O$	214.24
13	formate.....	.....	$HCOO \cdot C_7H_{15}$	144.13
14	Heptylene.....	heptene.....	$CH_3 \cdot (CH_2)_4 \cdot CH : CH_2$	98.11
15	Hesperidine.....	.....	$C_{22}H_{26}O_{12}$; $(C_{50}H_{60}O_{22})$	482.21
16	Hesperitinic acid.	.....	$C_{10}H_{10}O_4$	194.08
17	Hexabrom ethane	.....	$CBr_3 \cdot CBr_3$	503.50
18	Hexachlor benzene	.....	C_6Cl_6	284.74
19	ethane.....	.....	$CCl_3 \cdot CCl_3$	236.74
20	Hexadecane.....	.....	$C_{16}H_{34}$	226.27
21	Hexaethyl benzene	.....	$C_6(C_2H_5)_6$	246.24
22	Hexahydro-anthracene	.....	$C_{14}Hi_6$	184.13
23	benzene.....	.....	C_6H_{12}	84.10
24	benzoic acid....	.....	$C_6H_{11} \cdot COOH$	128.10
25	cumene.....	.....	$C_6H_{11} \cdot C_3H_7$	126.14
26	cymene (p.)....	.....	$CH_3 \cdot C_6H_{10} \cdot C_3H_7$	140.16
27	mellitic acid....	.....	$C_6H_6(COOH)_6$	348.10
28	mesitylene.....	.....	$C_6H_9(CH_3)_3$ (1, 3, 5)	126.14
29	naphthalene....	.....	$C_{10}H_{14}$	134.11
30	phenol.....	.....	$C_6H_5OHH_6$	100.10
31	pyridene.	See *piperidine*		
32	salicylic acid....	.....	$HO \cdot C_6H_{10} \cdot COOH$	144.10
33	toluene.....	.....	$C_6H_{11} \cdot CH_3$	98.11
34	zylene (m.).....	.....	$C_6H_{10}(CH_3)_2$	112.13
35	" (p.).....	.....	$C_6H_{10}(CH_3)_2$	112.13
36	Hexahydroxy.... benzene.....	.....	$C_6(OH)_6$	174.08
37	Hexaiodobenzene.	.....	C_6I_6	833.58
38	Hexamethyl benzene	.....	$C_6(CH_3)_6$	162.14
39	Hexamethylene-tetramine	urotropine.....	$C_6H_{12}N_4$	140.12
40	Hexane (n.).....	.....	$CH_3(CH_2)_4CH_3$	86.1
41	Hexenyl alcohol..	.....	$C_6H_{11}OH$	100.1

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form and color	Sp. gr. $H_2O = 1$ (A) Air = 1	Melting-point °C	Boiling-point °C	Solubility in gms. per 100 c.c. of		
					Water	Alcohol	Ether
1	colorl. need.	.....	185 d. (195)	.....	sl. s.	.....	s.
2	.....	.....	.....	175.5	.....	.....	.....
3	cryst.	.....	180	subl.	v. s.	sl. s.	.....
4	oil.....	$0.8094^{20°}$	.....	117	i.	v. s.	v. s.
5	colorl. liq.	0.689	.....	98.4	i.	100	∞
6	colorl.	0.921	−10	224	0.24^{15}	s.	s.
7	.....	$0.9342^{0°}$	.....	268.71	i.	s.	s.
8	liq.	0.874	.....	190	i.	s.	s.
9	colorl. liq.	0.830	.....	175.8	s.	∞	∞
10	colorl. liq.	0.822	.....	153–5	sl. s.	s.	∞
11	colorl. liq.	$0.78^{20°}$	.....	155–7	v. sl. s.	∞	∞
12	colorl. liq.	$0.815^{0°}$	.....	261	i.	s.	s.
13	colorl. liq.	$0.894^{0°}$	.....	176–7	i.	.....	s.
14	colorl. liq.	$0.703^{19°}$	.....	98–9	i.	s.	s.
15	sm. need.	.....	251 d.	.....	sl. s.	sl. s.	i.
16	need.	.....	228	.....	v. s. h.	v. s.	v. s.
17	rhombic	.....	d. 210	.....	i.	sl. s.	sl. s.
18	monocl.	$2.044^{23°}$	229	326	i.	i. c.	v. sl. s.
19	rhomb. tabl.	.....	184–7	subl.	i.	v. s.	v. s.
20	colorl. leaf.	$0.775^{18°}$	18	287.5–91.0	i.	∞	∞
21	colorl. monocl.	$0.831^{20°}$	129	298	i.	s.	v. s.
22	colorl. leaf.	.....	63	290	i.; v. s. bz.	v. s.	v. s.
23	colorl. liq.	$0.747^{0°}$	.....	79	i.	.....	.....
24	colorl. monocl.	1.048	30	233	sl. s.	v. s.	v. s.
25	colorl. liq.	$0.787^{20°}$	.....	147–50	i.	v. s.	v. s.
26	colorl. liq.	0.796	.....	171–3	i.	v. s.	v. s.
27	cryst.	.....	dec.	.....	v. s.	v. s.	v. s.
28	colorl. liq.	.....	.....	135–8	.....	.....	.....
29	colorl. liq.	$0.9343^{0°}$	.....	abt. 205	.....	.....	.....
30	.....	.....	17	160	.....	..	.....
31							
32	tab.	.....	111	.....	v. s.	v. s.	v. s.
33	colorl. liq.	$0.769^{20°}$	.....	101–2	i.	∞	∞
34	colorl. liq.	$0.771^{21°}$	.....	118–9	i.	∞	∞
35	colorl. liq.	$0.769^{20°}$	.....	120.5–1.0	.....	.....	.....
36	need.	.....	dec. 200	.....	sl. s.	sl. s.	sl. s.
37	red.-br. need.	.....	140–50 d.	.....	.....	.....	.....
38	colorl. rhomb.	.....	164	264	.....	sl. s.	.....
39	rhomb. f. al.	.....	230–70 sub. vac.	.....	$83^{18°}$	3	v. sl.
40	colorl. liq.	$0.660^{20°}$	−94	69	i.	$50^{38°}$	∞
41	colorl. liq.	$0.891^{10°}$	.....	137	v. s.	∞	∞

No.	Name	Synonyms	Formula	Mol. wt.
1	Hexoic aldehyde..	.....	$CH_3(CH_2)_4CHO$....	100.10
2	Hexyl acetate (n.)	.....	$CH_3 \cdot COOC_6H_{13}$....	144.13
3	alcohol.....	.....	$CH_3 \cdot (CH_2)_4 \cdot CH_2OH$	102.11
4	formate.....	.....	$HCOOC_6H_{13}$.....	130.11
5	Hexylene (n_D)....	.....	$CH_3(CH_2)_3CH : CH_2$	84.10
6	glycol (2, 3)....	.....	$C_3H_7CHOH \cdot CHOH \cdot CH_3$	118.11
7	iodide.....	.....	$C_6H_{12}I_2$.....	336.96
8	Hippuric acid....	benzoyl glycine...	$C_6H_5CO \cdot NH \cdot CH_2 \cdot COOH$	179.08
9	Homophthalic acid	.....	$C_6H_3(CH_3)(COOH)_2$	180.06
10	Homopyrocatechin	.....	$CH_3 \cdot C_6H_3 \cdot (OH)_2$ (1, 3, 4)	124.06
11	Homotropine....	.....	$C_{16}H_{21}O_3N$.....	275.18
12	hydrobromide ..	.....	$C_{16}H_{21}O_3N \cdot HBr$....	356.10
13	Hydantoin.....	glycolylurea.....	$CO \cdot NH \cdot CH_2 \cdot CO \cdot NH$	100.05
14	Hydantoic acid...	.....	$NH_2CONHCH_2 COOH$	118.06
15	Hydracetamide...	.....	$(CH_3CH)_3N_2$.....	112.11
16	Hydracrylic acid.	.....	$CH_2OH \cdot CH_2 \cdot COOH$	90.05
17	Hydrastin.....	.....	$C_{21}H_{21}O_6N$.....	383.18
18	hydrochloride...	.....	$C_{21}H_{21}O_6N \cdot HCl$....	419.64
19	Hydratropic acid.	.....	$C_6H_5CH(CH_3)COOH$	150.08
20	Hydrazo-benzene.	diphenylhydrazine (sym.)	$C_6H_5 \cdot NH \cdot NH \cdot C_6H_5$	184.11
21	benzoic acid (o.)	.....	$(HOOC \cdot C_6H_4 \cdot NH)_2$	272.11
22	" " (m.)	.....	$(HOOC \cdot C_6H_4 \cdot NH)_2$	272.11
23	" " (p.)	.....	$(HOOC \cdot C_6H_4 \cdot NH_2)_2$	272.11
24	naphthalene(1, 1′)	.....	$C_{10}H_7 \cdot NH \cdot NH \cdot C_{10}H_7$	284.14
25	" (2, 2′)	.....	$C_{10}H_7 \cdot NH \cdot NH \cdot C_{10}H_7$	284.14
26	toluene (o.).....	.....	$(CH_3 \cdot C_6H_4 \cdot NH)_2$	212.14
27	" (m.).....	.....	$(CH_3 \cdot C_6H_4 \cdot NH)_2$ ..	212.14
28	" (p.).....	.....	$(CH_3 \cdot C_6H_4 \cdot NH)_2$ ..	212.14
29	Hydrindene (1, 2)	.....	$C_6H_4 : C_2H_4 : CH_2$....	118.08
30	Hydrindone (α)..	.....	C_9H_8O.....	132.06
31	" (β)..	.....	$C_6H_4 \cdot CH_2 \cdot CO \cdot CH_2$	132.06
32	Hydro-acridine...	.....	$C_6H_4 \cdot CH_2 \cdot C_6H_4 \cdot NH$	181.10
33	anthracene. See	*dihydro-anthracene*		
34	anthranol.....	.....	$C_6H_4 \cdot CH_2C_6H_4CHOH$	196.10
35	atropic acid....	phenyl propionic acid (α)	$CH_2 \cdot CH(C_6H_5) \cdot COOH$	150.08
36	benzamide.....	tribenzaldiamine .	$(C_6H_5 \cdot CH)_3N_2$.....	298.16
37	benzoin.....	.....	$[C_6H_5 \cdot CH(OH) \cdot]_2$.	214.11

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form and color	Sp. gr. $H_2O = 1$ (A)Air = 1	Melting-point °C	Boiling-point °C	Solubility in gms. per 100 c.c. of		
					Water	Alcohol	Ether
1	liq.	$0.834^{20°}$	.....	116–8	i.	v. s.	v. s.
2	colorl. liq.	$0.890^{0°}$	.....	169.2	i.	v. s.	v. s.
3	colorl. liq.	$0.820^{20°}$	.....	157	sl. s.	∞	∞
4	colorl. liq.	$0.898^{0°}$	.....	153.6	.....	∞	∞
5	colorl. liq.	$0.683^{20°}$	−98.5	68–70	i.	∞	∞
6	.....	$0.9669^{0°}$	.....	207	∞	s.	s.
7	liq.	$2.024^{0°}$	.....	d.	.....	.....	.....
8	colorl. rh.	$1.371^{21°}$	187–90	.....	33^{20}	sl. s.	sl. s.
9	trim.	.....	185	.....	s. h.	s.	s.
10	colorl.	.....	51	251–2	v. s.	v. s.	v. s.
11	colorl. prisms	.....	96.5–7.5	.....	sl. s.	s.	s.
12	colorl. prisms	.....	213.8	.....	17.5^{25}	3.3	i.
13	need.	.....	216	.....	s. h.	s.	.....
14	monocl. pr.	.....	.....	.....	sl. s.	s. h.	v. sl. s.
15	yel. powd.	.....	.....	.....	v. s.	v. s.	.....
16	syrup	.....	.....	d.	.....	.....	.....
17	colorl. pr.	.....	132	.....	$0.025^{80°}$	$0.74^{25°}$	$0.8^{25°}$
18	powd.	.....	.....	.....	s.	.....	.....
19	liq.	.....	.....	264–5	.....	.....	.....
20	colorl. tab.	1.158	131 (126)	d.	v. sl. s.	$5^{16°}$	s.
21	colorl. leaf	.....	205	.....	i.	s.	.....
22	yel. cryst.	.....	.....	.....	i.	sl. s. h.	s. alk.
23	sm. need. f. al.	.....	.....	.....	i.	sl. s.	s. KOH
24	colorl. leaf.	.....	275	.....	i.	v. s.	v. s.
25	colorl. flocks	.....	162–4	.....	i.	sl. s.	v. s.
26	colorl. leaf	.....	165	d.	v. sl. s.	s.	s.
27	.....	.....	.....	.....	i.	s.	.....
28	colorl. monocl.	0.957	133–4 (128)	d.	i.	v. s.	v. s.
29	colorl. liq.	0.957	.....	176	i.	∞	∞
30	rhomb. tab.	$1.101^{45°}$	41	244	v. sl. s.	v. s.	s.
31	.....	.....	61	220 d.	.....	.....	.....
32	colorl. cryst. f. al.	.....	169	subl.	i.	s. h.	s.
33							
34	need.	.....	76	.....	s. h.	s.	s.
35	colorl. liq.	.....	.....	264–5	sl. s.	.....	.....
36	colorl. prisms	.....	101	.....	i.	v. s.	v. s.
37	leaf. f. al.	.....	138	abt. 300	0.25; c. 1.3 h.	v. s.	.....

No.	Name	Synonyms	Formula	Mol. wt.
1	Hydro-carbostyril		C_9H_9ON	147.08
2	cinnamic acid	phenyl propionic acid (β)	$C_6H_5 \cdot CH_2 \cdot CH_2 \cdot COOH$	150.08
3	" aldehyde		$C_6H_5 \cdot CH_2 \cdot CH_2 \cdot CHO$	134.08
4	coerulignone		$C_{12}(OH)_6(CH_3)_4$	306.13
5	coumaric acid (o.)		$HO \cdot C_6H_4(CH_2)_2 \cdot COOH$	166.08
6	" " (p.)	phenol propionic acid (β)	$HO \cdot C_6H_4(CH_2)_2 COOH$	166.08
7	cyanic acid	prussic acid	HNC	27.02
8	naphthoquinone (1, 2)		$C_{10}H_6(OH)_2$	160.06
9	naphthoquinone (1, 4)		$C_{10}H_6(OH)_2$	160.06
10	phenazine		$C_6H_4NHC_6H_4CH$	180.09
11	phthalic acid		$C_6H_6(COOH)_2$	168.06
12	terephthalic acid		$C_6H_6(COOH)_2$	168.06
13	quinone (p.)	See *quinol*		
14	quinone dimethyl ether		$C_6H_4(OCH_3)_2$	138.08
15	quinone ethyl ether		$HO \cdot C_6H_4 \cdot OC_2H_5$	138.08
16	quinonaphthalein		$C_{20}H_{12}O_3$	300.10
17	Hydroxy-acetic acid	See *glycollic acid*		
18	acrylic acid (β)		$CHOH : CH \cdot COOH$	88.03
19	anthraquinone (2)		$C_6H_4 : (CO)_2 : C_6H_3 \cdot OH$	224.06
20	azo benzene (o.)		$HO \cdot C_6H_4 \cdot N : N \cdot C_6H_5$	198.10
21	" " (p.)		$HO \cdot C_6H_4 \cdot N : N \cdot C_6H_5$	198.10
22	benzaldehyde (o.)	salicylaldehyde	$HO \cdot C_6H_4 \cdot CHO$	122.05
23	" (m.)		$HO \cdot C_6H_4 \cdot CHO$	122.05
24	" (p.)		$HO \cdot C_6H_4 \cdot CHO$	122.05
25	benzamide (o.)		$HO \cdot C_6H_4 \cdot CONH_2$	137.06
26	" (m.)		$HO \cdot C_6H_4 \cdot CONH_2$	137.06
27	" (p.)		$HO \cdot C_6H_4 \cdot CONH_2$	137.06
28	benzoic acid (o.)	salicylic acid (o.)	$HO \cdot C_6H_4 \cdot COOH$	138.05
29	" " (m.)		$HO \cdot C_6H_4 \cdot COOH$	138.05
30	" " (p.)		$HO \cdot C_6H_4 \cdot COOH$	138.05
31	benzyl alcohol (o.)	saligenin	$HO \cdot C_6H_4 \cdot CH_2OH$	124.06
32	" " (m.)		$HO \cdot C_6H_4 \cdot CH_2OH$	124.06
33	" " (p.)		$HO \cdot C_6H_4 \cdot CH_2OH$	124.06

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form and color	Sp. gr. $H_2O = 1$ (A) Air = 1	Melting-point °C	Boiling-point °C	Solubility in gms. per 100 c.c. of		
					Water	Alcohol	Ether
1	colorl. prisms f. al.	.....	163	.....	v. sl. s.	v. s.	v. s.
2	colorl. need.	$1.071^{49°}$	48.7	279.8	$0.59^{20°}$	v. s.	s.
3	colorl. liq.	.....	.....	208 (223)	i.	17	.....
4	monocl. pr. f. al.	.....	190	.....	sl. s.	s.	sl. s.
5	pr.	.....	82.3	.....	$1:20^{18°}$	s.	s.
6	colorl. monocl.	.....	128–9	.....	v. s. h.	v. s.	v. s.
7	colorl. liq.	$0.697^{18°}$	−10–12*	25.2	∞	∞	v.s. (∞)
8	colorl. leaf.	.....	60	.....	s. alk.	.....	.....
9	colorl. need.	.....	175	.....	s. h.	v. s. h.	v. s.
10	leaf.	.....	.....	.....	.....	.....	.....
11	monocl. tab.	.....	200 d.	.....	1 c.	s.	sl. s.
12	flocks...	.....	.....	.....	i.	.....	.....
13							
14	colorl. leaf.	.....	55–6	216.6	i.	s. bz.	.....
15	leaf.	.....	66	246–7	sl.	v. s.	v. s.
16	need. f. eth.	.....	232–4	d.	.....	s.	s.
17							
18	liq.	.....	.....	.....	v. s.	v. s.	v. s.
19	yel leaf.	.....	302	subl.	v. sl. s.	s.	s.
20	need.	.....	82.5–3.0	.....	sl. s.; s. alk.	s.	s.
21	prisms. f. al.	.....	152	.....	v. sl. h.	v. s.	v. s.
22	liq.	$1.159^{21°}$	−20	196.7	v. sl. s.	∞	∞
23	colorl. need.	.....	104	240	s. h.	v. s.	s.
24	colorl. need.	.....	115–6	sub.	sl. s.	v. s.	v. s.
25	yel. leaf.	.....	140	270 d.	s.	.....	.....
26	colorl. leaf.	.....	167 (170.5)	.....	sl. s. c.; s. h.	v. s.	v. s.
27	need.	.....	162	.....	sl. s.	v. s.	sl. s.
28	need. f. w.	.....	158	sub.	$0.18^{20°}$	$50^{15°}$	$23.4^{17°}$
29	colorl. rhomb.	.....	200	.....	$0.92^{18°}$	.....	9.7^{17}
30	colorl. monocl.	$1.404^{22°}$	210 (214)	dec.	$0.79^{15°}$	v. s.	9.4^{17}
31	rhombic	$1.161^{25°}$	86 (82)	sub.	$6.7^{22°}$	v. s.	v. s.
32	need.	.....	67	300 d.	v. s. h.	v. s.	v. s.
33	colorl. need.	.....	110 (125)	.....	s.	v. s.	v. s.

* Solidifies at −15° C.

PHYSICAL CONSTANTS OF

No.	Name	Synonyms	Formula	Mol. wt.
1	Hydrooxy butyric acid (α)	.....	$CH_3 \cdot CH_2CH(OH) \cdot COOH$	104.06
2	" " (β)	.....	$CH_3 \cdot CHOH \cdot CH_2 \cdot COOH$	104.06
3	" " (γ)	.....	$CH_2OH \cdot (CH_2)_2 \cdot COOH$	104.06
4	caproic acid (α).	oxycaproic acid ..	$CH_3 \cdot (CH_2)_3 \cdot CHOH \cdot COOH$	132.10
5	caprylic acid (α)	.....	$CH_3 \cdot (CH_2)_5 \cdot CHOH \cdot COOH$	160.13
6	cinnamic acid.	See *coumaric acid*		
7	citric acid.....	.....	$C_3H_5(OH)_2 \cdot (COOH)_3$	208.06
8	diphenyl (p.)...	.....	$C_6H_5 \cdot C_6H_4OH$.....	170.08
9	diphenylamine (m.)	.....	$C_6H_5 \cdot NH \cdot C_6H_4OH$	185.10
10	" (p.)	.....	$C_6H_5 \cdot NH \cdot C_6H_4OH$	185.10
11	ethylamine.....	.....	$C_2H_4(OH)NH_2$.....	61.06
12	glutaric acid (α)	.....	$(COOH)_2CHOH(CH_2)_2$	148.06
13	" " (β)	.....	$HOCH(CH_2COOH)_2$	148.06
14	isobutyric acid(α)	acetonic acid.....	$(CH_3)_2 \cdot C(OH) \cdot COOH$	104.06
15	isocaprylic acid (α)	.....	$[(CH_3)_2CH]_2C(OH)COOH$	160.13
16	isophthalic acid (2) (1, 3)	.....	$HO \cdot C_6H_3 \cdot (COOH)_2 + H_2O$	200.06
17	isophthalic acid (4) (1, 3)	.....	$HO \cdot C_6H_3 \cdot (COOH)_2$	182.05
18	isophthalic acid (5) (1, 3)	.....	$HO \cdot C_6H_3 \cdot (COOH)_2 + 2H_2O$	218.08
19	methylbenzoic acid (o.)	.....	$C_6H_4(CH_2OH) \cdot COOH$	152.06
20	methyleneacetone	.....	$CH(OH) : CH \cdot CO \cdot CH_3$	86.05
21	naphthoic acid OH,COOH 1, 2	.....	$C_{10}H_6(OH)COOH$..	188.06
22	naphthoic acid (α) (α, α)	.....	$C_{10}H_6(OH)COOH$..	188.06
23	naphthoic acid 1, 8	.....	$C_{10}H_6(OH)COOH$..	188.06
24	naphthoic acid (β) (α, β)	.....	$C_{10}H_6(OH)COOH$..	188.06
25	naphthoic acid (γ) (α, β)	.....	$C_{10}H_6(OH)COOH$..	188.06
26	naphthoic acid (α, β)	.....	$C_{10}H_6(OH)COOH$..	188.06
27	naphthoic acid 2, 1	.....	$C_{10}H_6(OH)COOH$..	188.06
28	naphthoic acid (β)	.....	$C_{10}H_6(OH)COOH$..	188.06
29	naphthoquinone (α)	juglon.....	$C_{10}H_5O_2 \cdot OH$.....	174.05
30	" (β)	.....	$C_{10}H_5O_2 \cdot OH$.....	174.05

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form and color	Sp. gr. $H_2O = 1$ (A) Air = 1	Melting-point °C	Boiling point °C	Solubility in gms. per 100 c.c. of		
					Water	Alcohol	Ether
1	colorl.	.....	43	255–60 d.	s.	s.	s.
2	syrup	.....	.....	.....	.....	.....	.....
3	liq.	.....	−17	.....	.....	.....	.....
4	colorl.	.....	60–2	subl. 100	.....	.....	.....
5	pl.	.....	69.5	.....	v .sl. s.	v. s.	v. s.
6							
7	liq.	.....	.....	.....	v. s.	v. s.	v. s.
8	need. or leaf.	.....	165	305–8	s. h.	s.	s.
9	leaf.	.....	82	340	.....	s.	.....
10	leaf. f. w.	.....	70	330	s. h.	s.	s.
11	.....	.....	.....	171	.....	.....	.....
12	sm. cryst.	.....	72–3	.....	s.	.....	.....
13	Exists only as methyl ester.						
14	colorl. pr.	.....	79	212	v. s.	v. s.	v. s.
15	need.	.....	110–1	.....	sl. s.	s.	s.
16	colorl. need.	.....	243	.....	v. sl. s. c.; s. h.	v. s.	v. s.
17	colorl. need.	.....	305	.....	sl. s. h.	v. s.	v. s.
18	colorl. need.	.....	288	sub.	$18^{100°}$; sl. s. c.	v. s.	v. s.
19	need.	.....	120	.....	.....	v. s.	v. s.
20	.....	.....	.....	.....	.....	.....	.....
21	need. f. al. and eth.	.....	187	.....	sl. s. h.	s.	s.
22	long. need. f. w.	.....	234–7	subl.	sl. s. h	v. s.	.....
23	need. f. eth.	.....	169	.....	s.	v. s.	s.
24	need. f. w.	.....	245–7	.....	s. h.	s.	.....
25	sm. need. f. w.	.....	187	.....	s. h.	v. s.	.....
26	long. need. f. w.	.....	210–1	.....	s. h.	.....	.....
27	need. f. dil. al.	.....	156–7	.....	v. sl. s.	v. s. abs.	.....
28	rhomb. lvs. f. w.	.....	216	.....	s. h.	s.	s.
29	red. br. or pr. f. chl.	.....	151–4	.....	v. s. chl.	s. acet. a. h.	sl. s.
30	yel. need.	.....	190 d.	subl.	sl. s. h.	s.	s.

No.	Name	Synonyms	Formula	Mol. wt.
	Hydro-oxy			
1	nicotinic acid		$C_5H_3N(OH)COOH$	139.05
2	phenylacetic acid (o.)		$HO \cdot C_6H_4 \cdot CH_2 \cdot COOH$	152.06
3	" " (m.)		$HO \cdot C_6H_4 \cdot CH_2 \cdot COOH$	152.06
4	" " (p.)		$HO \cdot C_6H_4 \cdot CH_2 \cdot COOH$	152.06
5	phenylethylamine (p.)		$HO \cdot C_6H_4 \cdot CH_2 \cdot CH_2 \cdot NH_2$	137.10
6	phthalic acid (3) (1, 2)		$HO \cdot C_6H_3(COOH)_2$	182.05
7	phthalic acid (2)		$HO \cdot C_6H_3(COOH)_2$	182.05
8	phthalic acid (4) (1, 2)		$HO \cdot C_6H_3 \cdot (COOH)_2$	182.05
9	propionic acid (α)	See *lactic acid*		
10	pyridine (2)	α pyridone	$HO \cdot C_5H_4N$	95.05
11	" (3)	β pyridone	$HO \cdot C_5H_4N$	95.05
12	" (4)	γ pyridone	$HO \cdot C_5H_4N + H_2O$	113.06
13	pyrotartaric acid		$CHOH(CH_2COOH)_2$	148.06
14	quinol (1, 2, 4)		$C_6H_3(OH)_3$	126.05
15	quinaldine (o.)		$C_{10}H_9NO$	159.08
16	" (p.)		$C_{10}H_9NO$	159.08
17	" (m?)		$C_{10}H_9NO$	159.08
18	" (γ)		$C_{10}H_9NO$	159.08
19	quinoline (2)	carbostyril (pr. 2)	$HO \cdot C_9H_6N$	145.06
20	" (bz. 1) (8)		$HO \cdot C_9H_6N$	145.06
21	" (bz. 2) (7)		$HO \cdot C_9H_6N$	145.06
22	" (bz. 3) (6)		$HO \cdot C_9H_6N$	145.06
23	" (bz. 4) (5)		$HO \cdot C_9H_6N$	145.06
24	" (4)	kyanuran	$HO \cdot C_9H_6N + 3H_2O$	199.11
25	stearic acid		$C_{18}H_{36}O_3$	300.29
26	succinic acid.	See *malic acid*		
27	terephthalic acid (2) (1, 4)		$HO \cdot C_6H_3(COOH)_2$	182.05
28	terephthalic acid (1, 4, 3)		$HO \cdot C_6H_3(COOH)_2$	182.05
29	toluic acid (1, 2, 3)		$CH_3 \cdot C_6H_3 \cdot (COOH)(OH)$	152.06
30	" " (1, 2, 4)		$CH_3 \cdot C_6H_3 \cdot (COOH)(OH)$	152.06
31	" " (1, 2, 5)		$CH_3 \cdot C_6H_3 \cdot (COOH)(OH) + \frac{1}{2}H_2O$	161.07
32	" " (1, 2, 6)		$CH_3 \cdot C_6H_3 \cdot (COOH)(OH)$	152.06
33	" " (1, 3, 2)		$CH_3 \cdot C_6H_3 \cdot (COOH)(OH)$	152.06
34	" " (1, 3, 4)		$CH_3 \cdot C_6H_3 \cdot (COOH)(OH)$	152.06

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form and color	Sp. gr. $H_2O = 1$ (A) Air = 1	Melting-point °C	Boiling-point °C	Solubility in gms. per 100 c.c. of		
					Water	Alcohol	Ether
1	need.	.....	303 d.	subl.	sl. s. h.	sl. s.	sl. s.
2	need. f. eth.	.....	137	.....	s.	.....	.....
3	need.f. bz. and lgr.	.....	129	.....	v. s.	v. s.	v. s.
4	pr. need. f. w.	.....	148	.....	v. s. h.	v. s.	v. s.
5	need.	.....	160	$180^{8mm.}$	sl. s.	1 : 10 h.	s. bz.
6	colorl. pr.	.....	d.	.....	$20^{17°}$	s.	s.
7	powd.	.....	.....	subl.	sl. s.	v. s.	s.
8	colorl. rosettes	.....	181 d.	.....	$3^{10°}$	v. s.	s.
9							
10	colorl. need. f. bz.	.....	106–7	280–1	v. s.	v. s.	s.
11	need.	.....	129	.....	v. s.	v. s.	.....
12	colorl. monocl.	.....	148.5 anh.	.....	100	v. s.	v. sl. s.
13	need.	.....	108	.....	s.	s.	s.
14	colorl.	.....	140.5	.....	v. s.	v. s.	v.s .
15	tricl. pr. f. al.	.....	74	266–7 subl.	.....	.....	.....
16	.....	.....	213	.....	v. sl. s.	s.	s.
17	.....	.....	232–4	.....	i.	s. h.	s.
18	pr. f. w.	.....	230–1	.....	s. h.	s.	i.
19	colorl. pr. f. al.	.....	199–200	subl.	v. sl. s. c.; v. s. h.	v. s.	v. s.
20	pr. f. dil. al.	.....	75–6	266. $6^{752mm.}$	v. sl. s.	v. s.	sl. s.
21	pr. f. al.	.....	235–8	subl.	sl. s.	v. s.	.....
22	sm. pr. f. al.	.....	193	>360	v. sl. s.	sl. s.	v. sl. s.
23	sm. leaf.	.....	224	.....	s. alk.	.....	sl. s.
24	colorl.	.....	201	.....	$0.47^{15°}$	s.	sl. s.
25	wh. cryst.	.....	.....	.....	.....	.....	.....
26							
27	powd.	.....	subl.	.....	sl. s.	v. s.	s.
28	powd.	.....	subl.	.....	sl. s. h.	s.	s.
29	need. f. w.	.....	168	.....	$0.14^{25°}$	v. s.	v. s.
30	need. f. w.	.....	172 (183)	.....	sl. s.	v. s.	v. s.
31	sm. need. f. w.	.....	177 anh.	.....	sl. s.	v. s.	v. s.
32	glit. need. f. w.	.....	145–6 (183)	.....	s.	v. s.	v. s.
33	long need. f. w.	.. ..	163–4	.....	v. s. h.	s. chl.	v. s.
34	long. need. f. w.	.....	151	.....	v. sl. s.	v. s.	.....

No.	Name	Synonyms	Formula	Mol. wt.
1	Hydroxy toluic acid (1, 3, 5)	.....	$CH_3 \cdot C_6H_3 \cdot (COOH)(OH)$	152.06
2	" " (1, 3, 6)	.....	$CH_3 \cdot C_6H_3 \cdot (COOH)(OH) + \frac{1}{2}H_2O$	161.07
3	" " (1, 4, 2)	.....	$CH_3 \cdot C_6H_3 \cdot (COOH)(OH)$	152.06
4	" " (1, 4, 3)	.....	$CH_3 \cdot C_6H_3 \cdot (COOH)(OH)$	152.06
5	" " (1, 5, 2)	.....	$CH_3 \cdot C_6H_3(COOH) \cdot OH$	152.06
6	urea	.....	$NH_2 \cdot CO \cdot NH(OH)$	76.05
7	valeric acid (α)	.....	$CH_3 \cdot (CH_2)_2 \cdot CH(OH) \cdot CO_2H$	118.08
8	Hyoscine	scopolamine	$C_{17}H_{21}O_4N$	303.18
9	hydrobromide	.....	$C_{17}H_{21}O_4N \cdot HBr + 3H_2O$	438.15
10	Hyoscyamine	.....	$C_{17}H_{23}O_3N$	289.19
11	hydrobromide	.....	$C_{17}H_{23}O_3NHBr$	370.12
12	Hypnoacetin	.....	$C_{16}H_{15}O_3N$	269.13
13	Hypnone	phenacyl bromide	$C_6H_5 \cdot CO \cdot CH_2 \cdot Br$	198.97
14	Hypogaeic acid	.....	$C_{15}H_{29} \cdot COOH$	254.24
15	Hypoxanthine	.....	$C_5H_4ON_4$	136.06
16	Hystazarine	.....	$C_{14}H_8O_4$	240.06
17	Imesatin	.....	$C_6H_4C(NH)CONH$	146.06
18	Imino-acetic acid	.....	$NH \cdot (CH_2COOH)_2$	133.06
19	aceto-nitrile	.....	$NH \cdot (CH_2 \cdot CN)_2$	95.06
20	ethyl alcohol	.....	$NH \cdot (CH \cdot CH_2 \cdot OH)_2$	103.08
21	Imperatorin	peucedanin	$C_{16}H_{16}O_4$	272.13
22	Indanthrene	dihydroanthraquinonazine	$C_{14}H_6O_2(NH)_2C_{14}H_6O_2$	442.13
23	Indene	.....	$C_6H_4CH:CH \cdot CH_2$	116.06
24	Indican	.....	$C_{14}H_{17}O_6N + 3H_2O$	349.19
25	Indigo	indigotine	$C_{16}H_{10}O_2N_2$	262.10
26	carmine	soluble indigo	$C_{16}H_8O_2N_2(SO_3Na)_2$	466.20
27	dicarboxylic acid	.....	$C_{18}H_{10}O_6N_2$	350.10
28	disulfonic acid	.....	$C_{16}H_8N_2O_2(SO_3H)_2$	422.22
29	purpurin	.....	C_8H_5NO	131.05
30	sulfonic acid	.....	$C_{16}H_9N_2O_2(SO_3H)$	342.15
31	white	.....	$C_{16}H_{12}N_2O_2$	264.11
32	Indirubin	.....	$C_{16}H_{10}N_2O_2$	262.10
33	Indole	benzopyrrol	C_8H_7N	117.06
34	Indophenin	.....	$C_{12}H_7NOS$	213.13

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form and color	Sp. gr. $H_2O = 1$ (A) Air = 1	Melting-point °C	Boiling-point °C	Solubility in gms. per 100 c.c. of		
					Water	Alcohol	Ether
1	tabl. f. w.	.....	208 (210)	subl.	s.	.....	.....
2	need. f. w.	.....	172–3 anh.	.....	s. h.	v. s.	v. s.
3	long. need.	.....	206–7	subl.	v. sl. s.	v. s.	s.
4	monocl. f. al.	.....	177	.....	v. sl. s.	s.	.....
5	long. need. f. w.	.....	151	.....	s. h.	v. s.	v. s.
6	colorl. need.	.....	128–30	.....	v. s.	s.	.....
7	colorl. need.	.....	31	.....	v. s.	v. s.	v. s.
8	colorl. prisms	.....	56–7	.....	$10.5^{15°}$	v. s.	v. s.
9	colorl. rhomb.	.....	193–4	.....	$66.6^{25°}$	$6.3^{25°}$	i.
10	need.	.....	108.5	.....	5.	v. s.	s.
11	prisms	.....	151.8	.....	v. s.	50	0.06
12	colorl. leaf. f. al.	.....	160	.....	v. sl. s.	$0.28^{35°}$	v. sl. s.
13	pr.	.....	50	.....	i.	v. s.	v. s.
14	colorl. need.	.....	33	.....	i.	v. s.	s.
15	need.	.....	d. 150	.....	$0.07^{19°}$; $1.4^{100°}$	.....	.....
16	yel. need.	.....	260	.....	.....	sl. s.	sl. s.
17	yel. pr.	.....	.....	.....	i.	s.	sl. s.
18	colorl. rhomb.	.....	abt. 225	.....	$2.43^{5°}$	i.	i.
19	colorl. lf. f. etb.	.....	75	.....	s.	s.	sl. s.
20	colorl.	.....	28	270	∞	∞	∞
21	rhomb. pr.	.....	75	.....	i.	s. h.	s.
22	blue	.....	.....	.....	i.	i.	.....
23	.....	$1.04^{15°}$	.....	180	.....	.....	.....
24	br. liq.	.....	176–7 anh.	dec.	v. s.	v. s.	s.
25	rhomb.	.....	390–2 d.	.....	i.; s. h. anil.	i.	i.; s. h. chl.
26	blue powd.	.....	.....	.....	s.	sl. s.	.....
27	blue powd.	.....	.....	.....	i.; s. H_2SO_4	i.	i.
28	blue amor.	.....	.....	.....	s.	s.	.....
29	need....	.....	.....	.....	i.	s.	s.
30	purple	.....	.....	200 d.	s.	s.	.....
31	wh. powd.	.....	.....	.....	i.; s. alk.	s.	s.
32	br. need.	.....	.....	.....	.....	.....	.....
33	colorl. leaf.	.....	52	253–4	s. h.	v. s.	v. s.
34	bl. need.	.....	.....	.....	i.	sl. s.	sl. s.

No.	Name	Synonyms	Formula	Mol. wt.
1	Indoxyl		$C_6H_4C(OH):CH\cdot NH$	133.16
2	Indoxylic acid		$C_9H_7NO_3$	177.16
3	Inulin		$(C_6H_{10}O_5)_6 + H_2O$	990.50
4	Inosite (i.)		$C_6H_{12}O_6 + 2H_2O$	216.13
5	Iodeosine.	See *erythrosine*		
6	Iodinecyanide.	See *cyanogen iodide*		
7	Iodo-acetic acid		$CH_2I\cdot COOH$	185.96
8	aniline (o.)		$IC_6H_4\cdot NH_2$	218.99
9	" (m.)		$IC_6H_4\cdot NH_2$	218.99
10	" (p.)		$IC_6H_4\cdot NH_2$	218.99
11	benzene		C_6H_5I	203.97
12	ethylene		$CH_2\cdot:CHI$	153.96
13	propionic acid (α)		$CH_3\cdot CHI\cdot COOH$	199.97
14	" " (β)		$CH_2I\cdot CH_2\cdot COOH$	199.97
15	toluene (o.)		$IC_6H_4\cdot CH_3$	217.99
16	" (m.)		$IC_6H_4\cdot CH_3$	217.99
17	" (p.)		$IC_6H_4\cdot CH_3$	217.99
18	Iodoform		CHI_3	393.80
19	Iodosobenzene		C_6H_5IO	219.97
20	Iodoxybenzene		$C_6H_5IO_2$	235.97
21	Ionone (α)		$C_{13}H_{20}O$	192.16
22	" (β)		$C_{13}H_{20}O$	192.16
23	" semicarbazone (α)		$C_{13}H_{20}:N\cdot NHCO\cdot NH_2$	249.21
24	" " (β)		$C_{13}H_{20}:N\cdot NHCO\cdot NH_2$	249.21
25	Irone		$C_{13}H_{20}O$	192.16
26	Isatine		$C_8H_5O_2N$	147.05
27	chloride		C_8H_4ONCl	165.50
28	Isatinic acid		$NH_2\cdot C_6H_4\cdot CO\cdot COOH$	165.06
29	Isatoic acid anhydride		$C_6H_4COO\cdot CONH$	163.05
30	Isatoxime		$C_8H_6O_2N_2$	162.06
31	Isatropic acid		$C_9H_8O_2$	148.06
32	Isoamyl-acetate		$CH_3\cdot COOC_5H_{11}$	130.11
33	acetic acid		$(CH_3)_2\cdot CH(CH_2)_3\cdot COOH$	130.11
34	alcohol	isobutyl carbinol.	$(CH_3)_2\cdot CH\cdot(CH_2)_2 OH$	88.10
35	" (sec.)	methyl isopropyl carbinol	$(CH_3)_2\cdot CH\cdot CH(OH) CH_3$	88.10
36	aldehyde		$(CH_3)_2CH\cdot CH_2\cdot CHO$	86.08
37	amine		$(CH_3)_2CH\cdot CH_2\cdot CH_2\cdot NH_2$	87.11
38	aniline		$C_5H_{11}NHC_6H_5$	163.14

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form and color	Sp. gr. $H_2O = 1$ (A)Air = 1	Melting-point °C	Boiling-point °C	Solubility in gms. per 100 c.c. of		
					Water	Alcohol	Ether
1	oil	.....	.....	not volatile	.....	.....	s. alk.
2	cryst.	.....	.....	122–3 subl. d.	sl. s.	.....	.....
3	micr. cryst.	1.539 anh.	160 d.	.....	$0.001^{15°}$	v. sl. s.	.....
4	colorl. monocl.	.....	225	.....	$17.5^{24°}$	i. abs.	i.
5							
6							
7	yel.	.....	82	dec.	i.	s.	v. sl. s.
8	need.	.....	57 (60–1)	.....	v. sl. s.	v. s.	.....
9	leaf.	.....	25–7	.....	i.	s.	.....
10	need. or pr.	.....	63 (67–8)	.....	i.	s.	.....
11	liq.	.....	−28.5	188.2	i.	s.	∞
12	"	$2.08^{0°}$	.....	56	i.	∞	∞
13	prisms	.....	44.5–5.5	.....	sl. s	v. s.	v. s.
14	leaf.	.....	82	.....	$8^{25°}$	v. s.	v. s.
15	liq.	$1.697^{20°}$	.....	211 (204)	i.	∞	∞
16	"	$1.698^{20°}$	.....	204	i.	∞	∞
17	leaf.	.....	35	211.5	i.	v. s.	v. s.
18	yel. hex.	.....	119 subl.	.....	$0.01^{25°}$	$1.3^{18°}$; $7.8^{78°}$	$13.6^{25°}$
19	amor.	.....	expl. abt. 210	.....	s.	s.	i.
20	need.	.....	expl. 230–8	.....	v. sl. s.	v. s. bz.	v. s. chl.
21	colorl. liq.	0.934	.....	$120 \cdot 6^{12mm}$	v. sl. s.	∞	∞
22	colorl. liq.	0.949	.....	$134 \cdot 6^{12mm}$	v. sl. s.	∞	∞
23	.....	.....	110	.....	.....	.....	.....
24	.....	.....	148	.....	.....	.....	.....
25	colorl. liq.	0.939	.....	144^{16mm}	v. sl. s.	v. s.	v. s.
26	red. need.	.....	198–9	subl.	v. sl. s. c.; s. h.	s.	sl. s.
27	f. al. br. need.	.....	180 d.	.....	i.	s.	v. s.
28	wh. powd.	.....	d.	.....	sl	.....	.....
29	monocl.	.....	240 d.	.....	$0.7^{100°}$	$3^{78°}$	sl. s.
30	yel. need.	.....	202 d.	.....	v. sl. s.	s.	s. alk.
31	cryst.	.....	237–7.5	.....	v. sl. sh.	sl. s.	.....
32	colorl. liq.	0.876	.....	139	$0.16^{25°}$	∞	∞
33	colorl. liq.	$0.912^{9°}$	.....	209	sl. s. h.	∞	∞
34	colorl. liq.	$0.810^{20°}$	.....	130	$3.3^{22°}$	∞	∞
35	colorl. liq.	$0.819^{19°}$	.....	112.5	sl. s.	∞	∞
36	liq.	$0.768^{12.6°}$	.....	92.5	sl. s.	s.	.....
37	colorl. liq.	0.747	.....	95	v. sl. s.	∞	∞
38	liq.	$0.928^{15°}_{4°}$	.....	258	.....	.....	.....

PHYSICAL CONSTANTS OF

No.	Name	Synonyms	Formula	Mol. wt.
	Isoamyl-			
1	benzene		$C_6H_5 \cdot C_5H_{11}$	148.1
2	benzoate		$C_6H_5 \cdot COOC_5H_{11}$	192.1
3	bromide		$(CH_3)_2 \cdot CH \cdot (CH_2)_2 Br$	151.0
4	butyrate		$C_3H_7 \cdot COOC_5H_{11}$	158.1
5	chlorcarbonate		$Cl \cdot COOC_5H_{11}$	150.5
6	chloride		$(CH_3)_2 \cdot CH \cdot (CH_2)_2 Cl$	106.5
7	cyanide	capronitrile	$(CH_3)_2 \cdot CH \cdot (CH_2)_2 \cdot CN$	97.1
8	ether		$C_5H_{11} \cdot O \cdot C_5H_{11}$	158.1
9	formate		$H \cdot COOC_5H_{11}$	116.1
10	iodide		$(CH_3)_2 \cdot CH \cdot (CH_2)_2 I$	198.0
11	isobutyrate		$(CH_3)_2 \cdot CH \cdot COOC_5 H_{11}$	158.1
12	isocyanide		$(CH_3)_2 \cdot CH \cdot (CH_2)_2 \cdot NC$	97.1
13	isovaleriate		$C_4H_9 \cdot COOC_5H_{11}$	172.1
14	mustard oil		$C_5H_{11} \cdot NCS$	129.1
15	nitrate		$(CH_3)_2 \cdot CH \cdot (CH_2)_2 \cdot NO_3$	133.1
16	nitrite		$(CH_3)_2 \cdot CH \cdot (CH_2)_2 \cdot NO_2$	117.1
17	phenol (p.)		$C_5H_{11} \cdot C_6H_4 \cdot OH$	164.1
18	phenyl ketone		$C_5H_{11} \cdot CO \cdot C_6H_5$	176.1
19	propionate		$CH_3 \cdot CH_2 \cdot COOC_5 H_{11}$	144.1
20	salicylate		$HO \cdot C_6H_4 \cdot COOC_5 H_{11}$	208.1
21	sulfide		$(C_5H_{11})_2S$	174.2
22	urea		$NH_2 \cdot CO \cdot NH(C_5H_{11})$	130.1
23	urethane		$CO(NH_2)OC_5H_{11}$	131.1
24	Isoamylene		$(CH_3)_2CH \cdot CH : CH_2$	70.0
25	Isoanthraflavic acid		$C_{14}H_8O_4 + H_2O$	258.0
26	Isobutane	trimethyl methane	$(CH_3)_2 \cdot CH \cdot CH_3$	58.0
27	Isobutyl-acetate		$CH_3 \cdot COOC_4H_9$	116.1
28	alcohol	isopropyl carbinol	$(CH_3)_2 \cdot CH \cdot CH_2OH$	74.0
29	aldehyde		$(CH_3)_2 \cdot CH \cdot CHO$	72.0
30	amine		$(CH_3)_2 \cdot CH \cdot CH_2 \cdot NH_2$	73.1
31	benzene		$C_6H_5 \cdot C_4H_9$	134.1
32	benzoate		$C_6H_5 \cdot COOC_4H_9$	178.1
33	bromide		$(CH_3)_2 \cdot CH \cdot CH_2Br$	136.9
34	butyrate		$C_3H_7 \cdot COOC_4H_9$	144.1
35	chlorcarbonate		$Cl \cdot COOC_4H_9$	136.5
36	chloride		$(CH_3)_2 \cdot CH \cdot CH_2Cl$	92.5
37	cyanide	isovaleronitrile	$(CH_3)_2 \cdot CH \cdot CH_2 \cdot CN$	83.0
38	ether		$C_4H_9 \cdot O \cdot C_4H_9$	130.1
39	formate		$H \cdot COOC_4H_9$	102.0
40	formic acid		$(CH_3)_2CH \cdot CH_2 \cdot COOH$	102.0

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form and color	Sp. gr. $H_2O = 1$ (A)Air = 1	Melting-point °C	Boiling-point °C	Solubility in gms. per 100 c.c. of		
					Water	Alcohol	Ether
1	colorl. liq.	$0.885^{18°}$	.....	193 (201)	i.	∞	∞
2	colorl. liq.	$0.993^{19°}$	.....	261	i.	s.	.....
3	colorl. liq.	1.219	.....	120–0.6	i.	s.	.....
4	colorl. liq.	$0.882^{0°}$	.....	178.6	v. sl. s.	v. s.	v. s.
5	colorl. liq.	$1.024^{\frac{25}{25}°}$	.....	151–6	dec.	∞	∞
6	colorl. liq.	0.880	.....	100–1	i.	s.	∞
7	liq.	0.807	.....	155.5	i.	s.	∞
8	colorl. liq.	0.781	.....	173	i.	.....	∞
9	colorl. liq.	$0.894^{0°}$	.....	123.3	v. sl. s.	s.	∞
0	liq.	$1.473^{20°}$	.....	148.2	i.	s.	∞
1	colorl. liq.	$0.876^{0°}$	.....	168.8	.....	s.	s.
2	liq.	.....	.....	137	i.	s.	s.
3	colorl. liq.	$0.858^{19°}$	.....	194	v. sl. s.	s.	s.
4	liq.	0.942	.....	183–4	v. sl. s.	v. s.	v. s.
5	liq.	$1.000^{7.5°}$	.....	147	v. sl. s.	s.	v. s.
6	liq	0.880	.....	94–5	v. sl. s.	∞	∞
7	need. f. h. w.	.....	92–3	255	v. sl. s. h.	v. s.	v. s.
8	colorl. liq.	.....	.....	241.5–2.5	i.	v. s.	v. s.
9	colorl. liq.	$0.888^{0°}$	.....	160.2	$0.09^{25°}$	s.	s.
0	colorl. liq.	$1.045^{\frac{25}{25}°}$	.....	270	i.	v. s.	∞
1	colorl. liq.	$0.843^{20°}$	.....	213–16	i.	v. s.	v. s.
2	colorl.	.....	89–91	.....	sl. s.	.....	.....
3	.....	.....	60	220	s. h.	s.	s.
4	.....	.....	.....	25	.....	.....	.....
5	long. yel. need.	.....	330	subl.	s. alk.	s.	v. sl. s.
6	gas	*$0.603^{0°}$	.....	–11	i.	s.	s.
7	colorl. liq.	$0.871^{20°}$	.....	116.3	$0.63^{25°}$	∞	∞
8	colorl. liq.	0.806	–108	106.5	$9.5^{18°}$	∞	∞
9	colorl. liq.	$0.794^{20°}$	.....	63–4	11	∞	∞
0	colorl. liq.	0.735	.....	68	∞	∞	∞
1	colorl. liq.	0.873	.....	171–1.5	i.	∞	∞
2	colorl. liq.	1.062	.....	237 (241.5)	i.	∞	∞
3	liq.	1.260	.....	90–1	i.	∞	∞
4	colorl. liq.	0.866	.....	156.9	v. sl. s.	∞	∞
5	liq.	$1.040^{\frac{25}{25}°}$	.....	127–30	dec.	∞	∞
6	colorl. liq.	0.880	.....	69	i.	∞	∞
7	liq.	$0.807^{20°}$	.....	129–9.5	sl. s.	∞	∞
8	colorl. liq.	.....	.....	122–2.5	sl. s.	∞	∞
9	colorl. liq.	$0.885^{20°}$	.....	98.5	1	∞	∞
0	.....	$0.8854^{0°}$	.....	97.9	1 : 99	.....	.....

* Specific gravity of the liquid.

No.	Name	Synonyms	Formula	Mol. wt.
1	Isobutyl-iodide		$(CH_3)_2CH \cdot CH_2I$	184.00
2	isoamyl		$(CH_3)_2CH(CH_2)_3 \cdot CH(CH_3)_2$	128.16
3	isocyanide		$(CH_3)_2 \cdot CH \cdot CH_2 \cdot NC$	83.08
4	isovaleirate		$C_4H_9 \cdot COO \cdot C_4H_9$	158.14
5	ketone		$C_4H_9 \cdot CO \cdot C_4H_9$	142.14
6	mustard oil		$C_4H_9 \cdot NCS$	115.14
7	nitrate		$(CH_3)_2 \cdot CH \cdot CH_2 \cdot NO_3$	119.07
8	nitrite		$(CH_3)_2 \cdot CH \cdot CH_2 \cdot NO_2$	103.08
9	phenyl ketone		$C_4H_9 \cdot CO \cdot C_6H_5$	162.11
10	Isobutylene		$(CH_3)_2C : CH_2$	56.06
11	Isobutyric acid		$(CH_3)_2 \cdot CH \cdot COOH$	88.06
12	amide		$(CH_3)_2 \cdot CH \cdot CONH_2$	87.08
13	anhydride		$[(CH_3)_2 \cdot CH \cdot CO]_2O$	158.11
14	Isocarbostyril	1 hydroxy-isoquinoline	C_9H_7ON	145.06
15	Isocholesterol		$C_{26}H_{43}OH$	372.35
16	" benzoate		$C_{26}H_{43}O \cdot C_7H_5O$	476.38
17	Isocinchomeronic acid	1, 4-pyridine dicarboxylic acid	$C_5H_3N \cdot (COOH)_2 + H_2O$	185.08
18	Isocinnamic acid		$C_6H_5 \cdot CH : CH \cdot COOH$	148.06
19	Isocitric acid		$C_6H_8O_7 + H_2O$	210.08
20	Isocrotonic acid		$CH_3 \cdot CH : CH \cdot COOH$	86.05
21	Isocoumarin		$C_6H_4 \cdot CH : CH \cdot OCO$	146.05
22	Isocymene (m.)		$CH_3 \cdot C_6H_4 \cdot CH(CH_3)_2$	134.11
23	Isodulcite	Rhamnose	$CH_3(CHOH)_4CHO + H_2O$	182.11
24	Isodurene		$C_6H_2(CH_3)_4$ (1, 2, 3, 5)	134.11
25	Isoeugenol(1, 3, 4)		$C_3H_5 \cdot C_6H_3(OCH_3) OH$	164.10
26	Isoferulic acid		$C_7H_7O_2 \cdot C_2H_2 \cdot COOH$	194.08
27	Isoglucosamine		$C_6H_{11}O_5(NH_2)$	179.11
28	Isoheptoic acid		$C_6H_{13}COOH$	130.11
29	Isohydrobenzoin		$C_{14}H_{12}(OH)_2$	214.11
30	Isomalic acid		$CH_3 \cdot C(OH)(COOH)_2$	134.03
31	Isomannid		$C_6H_{10}O_4$	146.08
32	Isomethylcyanurate		$C_3O_3N_3(CH_3)_3$	171.10
33	Isonaphthazarine	2, 3-α-dihydroxynaphthoquinone	$C_{10}H_4O_2(OH)_2$	190.04
34	Isonicotinic acid		$C_5H_4N \cdot COOH$ (4)	123.03
35	Isonitrosoacetone		$CH_3COCH : NOH$	87.04
36	Isopentane		$(CH_3)_2CHCH_2CH_3$	72.10

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form and color	Sp. gr. $H_2O = 1$ (A)Air = 1	Melting-point °C	Boiling-point °C	Solubility in gms. per 100 c.c. of		
					Water	Alcohol	Ether
1	colorl. liq.	1.614	−90.7	120	i.	∞	∞
2	.....	$0.7247^{0°}$	.....	132	.....	.....	.....
3	colorl. liq.	$0.7874^{4°}$	.....	114–7	sl. s.	s.	s.
4	colorl. liq.	$0.848^{\frac{20°}{4°}}$	.....	167–70	i.	∞	∞
5	colorl. liq.	$0.833^{20°}$	.....	181–2	i.	v. s.	v. s.
6	liq.	$0.943^{20°}$	.....	162	i.	v. s.	v. s.
7	colorl. liq.	1.021	.....	123	i.	∞	∞
8	liq.	$0.908^{0°}$	.....	67	.....	s.	.....
9	colorl. liq.	0.993	.....	225–6	i.	∞	∞
10	.....	.....	.....	−6	s. H_2SO_4	.....	.....
11	colorl. liq.	$0.945^{25°}$	.....	155	$20^{20°}$	∞	∞
12	colorl. leaf.	.....	128–9	216–20	v. s.	v. s.	sl. s.
13	colorl. liq.	0.957	.....	182.5	dec.	dec.	.....
14	colorl.	.....	208–9	.....	sl. s.	v. s.	sl. s
15	cryst.	.....	138	.....	.....	s.	s.
16	need.	.....	195	.....	s.	s.	v. s.
17	colorl. leaf.	.....	236	subl.	v. sl. s.	v. sl. s.	v. sl. s.
18	.....	.....	57	.....	.....	.....	.....
19	pr.	.....	.....	.....	v. sl. s.	v. sl. s.	v. sl. s.
20	need.	1.031	15.5	169–9.3	40	.....	...
21	.....	.....	47	285	i.	s.	s.
22	.....	$0.862^{20°}$	<−25	175–6	.....	.....	.....
23	colorl. monocl.	1.471	126	.....	$57^{18°}$	sl. s.	insol.
24	liq.	$0.896^{0°}$	.....	195–7	i.	s.	.....
25	liq.	$1.091^{\frac{15°}{15°}}$	.....	267.5	sl. s.	s.	s.
26	need.	.....	228	.....	sl. s. d.; s. h.	s.	s.
27	.....	.....	.....	.....	.....	i.	i.
28	liq.	.....	.....	210–13	.....	.....	.....
29	colorl. monocl.	.....	119.5	.....	$0.21^{15°}$	v. s.	v. s.
30	monocl.	.....	dec.	.....	v. s.	v. s.	v. s.
31	colorl. monocl.	.....	87	274 d.	v. s.	sl. s.	i.
32	pr.	.....	175	295	.....	.....	.....
33	red. br. need.	.....	subl.	.....	sl. s.	s.	s. alk.
34	colorl. need.	.....	315	.....	sl. s. c.; v. s. h.	v. sl. s.	v. sl. s.
35	leaf.	.....	65	subl.	v. s.	.....	v. s.
36	colorl. liq.	0.628	.....	31	i.	∞	∞

No.	Name	Synonyms	Formula	Mol. wt.
1	Isophthalic acid (m.)		$C_6H_4(COOH)_2$	166.05
2	aldehyde (m.)		$C_6H_4(CHO)_2$	134.05
3	nitrile		$C_6H_4(CN)_2$	128.05
4	Isoprene		$CH_2:CH\cdot C(CH_3):CH_2$	68.06
5	Isopropyl-acetate		$CH_3\cdot COO\cdot CH(CH_3)_2$	102.08
6	acetylene		$(CH_3)_2CH\cdot C:CH$	68.06
7	alcohol		$CH_2\cdot CH(OH)\cdot CH_3$	60.06
8	amine		$(CH_3)_2CHNH_2$	59.08
9	benzene	See *cumene*		
10	benzoic acid (o.)		$(CH_3)_2\cdot CH\cdot C_6H_4\cdot COOH$	164.10
11	bromide		$(CH_3)_2CH\cdot Br$	122.97
12	chloride		$(CH_3)_2CH\cdot Cl$	78.51
13	cyanide		$(CH_3)_2CH\cdot CN$	69.06
14	ether		$(CH_3)_2CH\cdot O\cdot CH(CH_3)_2$	102.11
15	ethylene		$(CH_3)_2CH\cdot CH:CH_2$	70.08
16	iodide		$(CH_3)_2CH\cdot I$	169.99
17	isocyanide		$(CH_3)_2CH\cdot NC$	69.06
18	ketone		$(CH_3)_2CH\cdot CO\cdot CH(CH_3)_2$	114.11
19	mercaptan		$(CH_3)_2CH\cdot SH$	76.13
20	methyl benzene (p.)	See *cymene* (p.)		
21	phenyl ketone		$(CH_3)_2CH\cdot CO\cdot C_6H_5$	148.10
22	pyridine (1)		$(CH_3)_2CH\cdot C_5H_4N$	121.10
23	pyridine (3)		$(CH_3)_2CH\cdot C_5H_4N$	121.10
24	sulfide		$(CH_3)_2CH\cdot S\cdot CH(CH_3)_2$	118.18
25	Isopurpurin	See *anthrapurpurin*		
26	Isoquinoline		C_9H_7N	129.06
27	Isosaccharic acid		$[CH(OH)\cdot CH(COOH)]_2O$	192.06
28	Iso-safrol		$CH_2O_2C_6H_3CH\cdot CH_3$	162.08
29	Isosuccinic acid	methyl malonic acid	$CH_3\cdot CH(COOH)_2$	118.05
30	Isovaleric acid		$(CH_3)_2CH\cdot CH_2\cdot COOH$	102.08
31	aldehyde		$(CH_3)_2CH\cdot CH_2\cdot CHO$	86.08
32	Isovanillin (1, 3, 4)		$C_6H_3(CHO)(OCH_3)OH$	152.06
33	Itaconic acid		$CH_2\cdot C(COOH)CH_2\cdot COOH$	130.03
34	Itamalic acid		$CH_2(OH)CH(COOH)CH_2\cdot COOH$	148.06
35	Kairoline	methyltetrahydroquinoline	$C_9H_{10}N\cdot CH_3$	147.11
36	Ketazine		$(CH_3)_2C:N_2:C(CH_3)_2$	112.13
37	Ketene		$CH_2:CO$	42.03
38	Ketine		$(CH_3)C:CHN:C(CH_3)CH:N$	108.08
39	Ketobutyric acid		$CH_3.CH_2.CO.COOH$	102.05

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form and color	Sp. gr. $H_2O = 1$ (A)Air = 1	Melting-point °C	Boiling-point °C	Solubility in gms. per 100 c.c. of		
					Water	Alcohol	Ether
1	colorl. need.	.....	abt. 300	subl.	$0.013^{0.52}$, 0.22 h.	s.	.....
2	need.	.....	89	.....	sl. s.	v. s.	.....
3	colorl. need.	.....	158–9	.....	sl. s.	s. h.	.....
4	colorl. liq.	$0.691^{0°}$	.....	35.8	i.	∞	∞
5	colorl. liq.	$0.917^{0°}$	.....	90–3	sl. s.	∞	∞
6	colorl. liq.	$0.635^{0°}$	.....	28–9	i.	∞	∞
7	colorl. liq.	$0.789^{20°}$	.....	82.8	∞	∞	∞
8	colorl. liq.	$0.690^{18°}$	.....	32.2	∞	∞	∞
9							
10	colorl. pr.	.....	51	.....	s. h.	.....	.....
11	colorl. liq.	$1.310^{25°}_{25°}$	.....	59–60	i.	∞	∞
12	colorl. liq.	$0.857^{25°}_{25°}$	.....	35–6	v. sl. s.	∞	∞
13	colorl. liq.	.....	.....	107–8	sl. s.	∞	∞
14	colorl. liq.	$0.725^{21°}$	.....	69	sl. s.	∞	∞
15	colorl. liq.	.....	.....	21.2	i.	∞	∞
16	liq.	$1.705^{25°}_{25°}$	.....	89.5	i.	∞	∞
17	colorl. liq.	$0.760^{0°}$	.....	87	i.	∞	∞
18	colorl. liq.	$0.806^{20°}$	.....	123.7	i.	∞	∞
19							
20	colorl. liq.	>1	.....	57–60	sl. s.	∞	∞
21	colorl. liq.	.....	.....	217	i.	s.	s.
22	liq.	$0.934^{0°}$	.....	158–9	sl. s.	∞	∞
23	liq.	$0.944^{0°}$	.....	177–8	.....	∞	∞
24	liq.	.....	.....	120.5	i.	s.	s.
25							
26	colorl.	$1.099^{20°}$	24.6	240.8	v. sl. s.	.....	.....
27	rhomb.	.....	185	dec.	v. s.	v. s.	v. s.
28	.....	.....	.....	249	i.	s.	.....
29	colorl. pr.	1.455	135 d.	.....	$44.3^{0°}$	v. s.	v. s.
30	colorl. liq.	$0.956^{22°}$	.....	176	$4.2^{20°}$	∞	∞
31	colorl. liq.	$0.820^{0°}$	.....	92.5	sl. s.	s.	s.
32	pr.	.....	116	.....	s. h.	s.	.....
33	rhomb.	1.57	161	d.	1 : 15	.....	.....
34	long. need.	.....	64	d.	deliq.	s.	s.
35	.....	.....	.....	245	.....	v. s.	sl. s.
36	.....	0.836	.....	131	s.	.....	.....
37	gas	.....	.....	–56	d.	s.	s.
38	.....	.....	.....	153	.....	.....	.....
39	oil	$1.200^{17°}$	.....	$78^{25mm.}$	.....	.....	.....

No.	Name	Synonyms	Formula	Mol. wt.
1	Ketoheptamethylene	.....	$(CH_2)_6CO$	112.10
2	Ketopentamethylene	.....	$(CH_2)_4CO$	84.06
3	Ketopyrrolidine ..	α, γ-butyrolactam	$NH(CH_2)_3C(=O)$	85.06
4	Kynurenic acid ..	γ-hydroxyquinoline-Py-carboxylic acid	$C_9H_5(OH)(COOH)N$	189.06
5	Lactamide.....	.....	$CH_3 \cdot CH(OH) \cdot CO \cdot NH_2$	89.06
6	Lactic acid (i.)...	.....	$CH_3 \cdot CH(OH) \cdot COOH$	90.05
7	anhydride.....	.....	$C_6H_{10}O_5$	162.08
8	Lactide.....	.....	$C_6H_8O_4$	144.09
9	Lactoic acid.....	.....	$CH_2OH(CHOH)_4COOH$	196.10
10	Lactose.....	milk sugar.....	$C_{12}H_{22}O_{11} + H_2O$...	360.19
11	Lactyl urea.....	.....	$C_4H_6O_2N_2 + H_2O$...	131.07
12	Laevulin.....	.....	$C_6H_{10}O_5$ at 100°	162.08
13	Laevulinic acid...	.....	$CH_3 \cdot CO \cdot (CH_2)_2 \cdot COOH$	116.06
14	aldehyde.....	.....	$CH_3 \cdot CO \cdot (CH_2)_2 \cdot CHO$	100.06
15	Laevulose.	See *fructose*		
16	Lauric acid.....	.....	$C_{11}H_{23} \cdot COOH$.....	200.19
17	aldehyde.....	.....	$C_{11}H_{23} \cdot CHO$	184.19
18	Lead tetraethyl ..	.....	$Pb(C_2H_5)_4$	323.36
19	tetramethyl	.....	$Pb(CH_3)_4$	267.30
20	triethyl....	.....	$Pb_2(C_2H_5)_6$	588.64
21	Lecithin.....	protagon.....	$C_{42}H_{84}PO_9N$	777.71
22	Lepidine.....	.....	$CH_3 \cdot C_9H_6N$ (py. 4)	143.08
23	Lepamine.....	.....	$C_{20}H_{32}N_2$	300.27
24	Leucaurine.....	.....	$CH(C_6H_4OH)_3$	292.13
25	Leucinic acid	.....	$C_5H_{10}(OH)COOH$..	132.10
26	Leucine (1).....	.....	$CH_3 \cdot (CH_2)_3 \cdot CH(NH_2) \cdot COOH$	131.11
27	Leuco-aniline....	.....	$(NH_2 \cdot C_6H_4)_2 \cdot CH \cdot C_6H_3 \cdot CH_2(NH_2)$	303.19
28	" " (p.)	.....	$CH(C_6H_4 \cdot NH_2)_3$...	289.18
29	Leuco-malachite-green	.....	$C_6H_5 \cdot CH \cdot [C_6H_4 \cdot N(CH_3)_2]_2$	330.22
30	Lichenin.....	moss starch.....	$(C_6H_{10}O_5)x$	(162.08
31	Lignoceric acid...	.....	$C_{24}H_{48}O_2$	368.38
32	Limonene (d. or l.)	.....	$C_{10}H_{16}$	136.13
33	Limonin.....	.....	$C_{22}H_{26}O_7$	412.29
34	Linalool (d. or l.).	.....	$C_{10}H_{18}O$	154.14

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form and color	Sp. gr. $H_2O = 1$ (A)Air = 1	Melting-point °C	Boiling-point °C	Solubility in gms. per 100 c.c. of		
					Water	Alcohol	Ether
1	oil	$0.9685^{0°}$	.....	178.5–95	sl. s.	v. s.	s.
2	.....	$0.9416^{21°}_{4}$	.....	130–0.5	.....	.....	.....
3	cryst.	.....	95	250	hydrol.	.....	.....
4	need.	.....	257	.....	v. sl. s.	s. h.	sl. s.
5	colorl.	$1.138^{80°}$	74	.....	v. s.	v. s.	.....
6	colorl. syrup.	1.249	.....	$119^{12mm.}$	∞	∞	∞
7	amor.	.....	250–60 d.	.....	v. sl. s.	v. s.	v. s.
8	colorl. monocl.	$0.862^{100°}$	128	255	v. sl. s. c.	v. sl. s.	.....
9	cryst.	.....	100; lactone	.....	s.	.....	.....
10	colorl. rh.	$1.525^{20°}$	abt. 200 d.	.....	17 c.; 40 h.	i.	i.
11	rhombs.	.....	anh. 145	.....	v. s.	v. s.	v. s.
12	amor.	.....	174	.....	deliq. ∞	$10^{22°}$,84 %	i.
13	colorl. leaf.	$1.137^{25°}$	33	245–6	v. s.	v. s.	v.s.
14	colorl. liq.	1.016	.....	1.86–8 d.	∞	∞	∞
15							
16	colorl. need.	$0.864^{60°}$	43.6 (48)	dec.	i.	s.	s.
17	colorl. leaf.	.....	44.5	184–5^{100mm}	i.	s.	s.
18	liq.	1.62	.....	198–202	i.	.....	.....
19	liq.	$2.031^{0°}$	.....	110	.....	.....	.....
20	liq.	1.471	.....	d.	i.	.....	.....
21	amor. waxy.	.....	d.	.....	i.	s.	s.
22	colorl. liq.	$1.086^{20°}$	.....	266 (261–3)	v. sl. s.	∞	∞
23	liq.	.....	.....	275	.....	.....	.....
24	need.	.....	.....	.....	sl. s.	s.	.....
25	pr. or need.	.....	78	subl. 100 +	s.	v. s.	v. s.
26	colorl. leaf.	$1\ 293^{18°}$	283–5 d.	.....	$2.4^{22°}$	$0.07^{17°}$; 0.12 h.	10.9 gl. ac. a.
27	colorl.	.....	abt. 100	.....	v. sl. s. h.	v. s.	v. sl. s.
28	colorl. leaf.	.....	148	.....	i.	s.	.....
29	colorl.	.....	93–4	.....	i.	v. s.	v. s.
30	amor.	.....	.....	.....	s. h.	i.	i.
31	need. f. al.	.....	80.5..	.....	s.bz.,CS_2, acet. a.	s.	s.
32	colorl. liq.	$0.853^{10°}$	.....	176.5	i.	∞	∞
33	micr. cryst.	.....	275	.....	v. sl. s.	s.	v. sl. s.
34	colorl. liq.	0.873	.....	195–9	v. sl. s.	∞	∞

No.	Name	Synonyms	Formula	Mol. wt.
1	Linalyl acetate		$CH_3 \cdot COOC_{10}H_{17}$	196.16
2	Linoleic acid		$C_{18}H_{32}O_2$	280.27
3	Lithofellic acid		$C_{20}H_{36}O_4$	340.29
4	Lophine		$C_{21}H_{16}N_2$	296.14
5	Lutidine (α)	dimethyl pyridine	$(CH_3)_2 \cdot C_5H_3N$	107.08
6	" (2, 4)	" "	$(CH_3)_2 \cdot C_5H_3N$	107.08
7	" (2, 6)	" "	$(CH_3)_2 \cdot C_5H_3N$	107.08
8	" (3, 4)	" "	$(CH_3)_2 \cdot C_5H_3N$	107.08
9	Lutidinic acid		$C_5H_3N \cdot (COOH)_2 + H_2O$	185.06
10	Maclurin		$COC_6H_2(OH)_3C_6H_3(OH)_2$	262.08
11	Malamide		$C_2H_3(OH)(CONH_2)_2$	132.09
12	Maleic acid		$COOH \cdot CH : CH \cdot COOH$	116.03
13	anhydride		$C_4H_2O_3$	98.02
14	Malic acid (d. or l.)		$COOH \cdot CH_2 \cdot CH(OH) \cdot COOH$	134.05
15	" " (i.)		$COOH \cdot CH_2 \cdot CH(OH)COOH$	134.05
16	Malonic acid		$CH_2 \cdot (COOH)_2$	104.03
17	amide		$CH_2 \cdot (CO \cdot NH_2)_2$	102.06
18	Malononitrile		$CH_2 \cdot (CN)_2$	66.03
19	Maltose	malt sugar	$C_{12}H_{22}O_{11} + H_2O$	360.19
20	Mandelic acid (i.)		$(C_6H_5 \cdot CH(OH) \cdot COOH$	152.06
21	Manitol (d.)	mannite	$C_6H_8(OH)_6$	182.11
22	Mannite hexanitrate		$C_6H_8(ONO_2)_6$	452.11
23	Mannoheptose (d.)		$C_6H_7(OH)_6CHO$	210.11
24	Mannose (d.)		$C_6H_{12}O_6$	180.10
25	Margaric acid		$C_{16}H_{33} \cdot COOH$	270.27
26	Maconic acid		$C_7H_4O_7 + 3H_2O$	254.08
27	Meconine		$C_{10}H_{10}O_4$	194.08
28	Melam		$C_6H_9N_{11}$	235.16
29	Melamine	cyanuric amide	$(CN \cdot NH_2)_3$	126.10
30	Melene		$C_{30}H_{60}$	420.48
31	Melilotic acid		$C_6H_4(OH)CH_2 \cdot CH_2 \cdot COOH$	166.08
32	Melissic acid		$C_{29}H_{59} \cdot COOH$	452.48
33	Mellitic acid		$C_6(COOH)_6$	342.05
34	Mellophanic acid		$C_{10}H_6O_8$	254.05
35	Menthene		$C_{10}H_{18}$	138.14
36	Menthol (l.)		$C_{10}H_{19}OH$	156.16
37	Menthone (l.)		$C_{10}H_{18}O$	154.14
38	Mercuric cyanide		$Hg(CN)_2$	252.67
39	fulminate		$Hg(ONC)_2 + \frac{1}{2}H_2O$	293.65

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form and color	Sp. gr. $H_2O = 1$ (A) Air = 1	Melting-point °C	Boiling-point °C	Solubility in gms. per 100 c.c. of		
					Water	Alcohol	Ether
1	colorl. liq.	0.91	.....	abt. 220d.	v. sl. s.	∞	∞
2	yel. oil.	0.921	<−18	.....	i.	∞	∞
3	micr.	.....	204	d.	i.	s.	.....
4	need.	.....	275	.....	i.	$0.88^{21°}$	$0.32^{20°}$
5	colorl. liq.	$0.947^{0°}$	.....	154–6.5	25	.....	.....
6	colorl. liq.	0.938	.....	157–9	20	.....	.....
7	colorl. liq.	$0.942^{0°}$	.....	142–3	∞ c.	.....	.....
8	colorl. liq.	.....	.....	163.5–4.5	.....	.....	.....
9	leaf.	.....	235	.....	s.	s.	i.
10	yel.	.....	.....	d.	s. h.	s.	s.
11	pr.	.....	.....	.....	s.	.....	.....
12	colorl. pr.	1.590	130–0.5	.....	$78.8^{25°}$ $392.6^{97.5°}$	$69.9^{29.7°}$	$8^{25°}$
13	colorl. trim.	$0.934^{19°}$	52.6	202	$16.32^{29.7°}$	v. sl. s. CCl_4	
14	colorl. need.	1.595	100	dec.	v. s.	sl. s.	sl. s.
15	colorl.	$1.601^{20°}$	128.5–9	dec.	$144^{26°}$ $411^{79°}$	v. s.	v. s.
16	colorl. tricl.	.....	132	dec.	>100	s.	s.
17	colorl. need.	.....	170	.....	$8.3^{8°}$	i. abs.	.....
18	colorl.	.....	29–30	218–9	13.3	40	20
19	fine need.	$1.540^{17°}$	.....	.....	v. s.	v. sl. s. c.	.....
20	colorl. rhomb.	$1.361^{4°}$	118	dec.	$16^{20°}$	s.	s.
21	colorl. need.	1.521	166	.....	$15.6^{18°}$	v. sl. abs.	i.
22	need.	$1.604^{0°}$	112–3	exp. 120	i.	$2.9^{13°}$	$4^{9°}$
23	need.	.....	134–5	.....	v. s.	sl. s.	.....
24	colorl. pr.	.....	132.3	.....	250	v. sl. s.	i.
25	colorl.	$0.853^{60°}$	59.9	$227^{100mm.}$	i.	sl. s.	v. s.
26	rhomb. ab.	.....	.....	.....	$25^{100°}$	sl. s.	sl. s.
27	colorl. need.	.....	102–2.5	.....	0.14 c.; 4.5 h.	.....	.....
28	or. powd.	.....	.....	.....	i.	s. KOH	.....
29	monocl.	.....	.....	.....	sl. s.	sl. s.	i.
30	colorl.	0.89	62	370–80	i.	s. h.	.....
31	need.	.....	82–3	d.	s.	s.	s.
32	colorl. sc.	.....	90	.....	i.	sl. s. c.; s. h.	v. sl. s.
33	colorl. need.	.....	286–8	d.	v. s.	s.	.....
34	cryst. f. w.	.....	238 anh.	.....	s.	.....	.....
35	.....	$0.8073^{20°}$	164.5–5.5	.....	.....	.....	.....
36	colorl. trim.	0.890	42	210	sl. s.	v. s.	v. s.
37	colorl. liq.	$0.896^{20°}$	.....	207	sl. s.	∞	∞
38	tetr.	4.011	d.	.....	s.	sl. s.	.....
39	rhombs.	.....	exp. 180	.....	$0.07^{12°}$	sl. s. h.	.....

PHYSICAL CONSTANTS OF

No.	Name	Synonyms	Formula	Mol. wt.
1	Mercury ethyl		$Hg(C_2H_5)_2$	258.69
2	mercaptide		$(C_2H_5S)_2Hg$	322.82
3	methyl		$Hg(CH_3)_2$	230.66
4	naphthyl		$Hg(C_{10}H_7)_2$	454.72
5	phenyl		$Hg(C_6H_5)_2$	354.69
6	Mesaconic acid		$CH_3(COOH)C:CHCOOH$	130.05
7	Mesidine		$(CH_3)_3C_6H_2\cdot NH_2$	135.11
8	Mesitol (1, 3, 5, 2)		$(CH_3)_3C_6H_2\ OH$	136.10
9	Mesityl oxide		$(CH_3)_2C:CH\cdot CO\cdot CH_3$	98.08
10	Mesitylene (1, 3, 5)		$(CH_3)_3C_6H_3$	120.10
11	Mesitylinic acid		$(CH_3)_2C_6H_3\cdot COOH$	150.08
12	Mesorcin		$C_6H(CH_3)_3(OH)_2$	152.10
13	Mesotartaric acid		$(HO)_2C_2H_2(COOH)_2 + H_2O$	168.06
14	Mesoxalic acid		$(HO)_2C(COOH)_2$	136.03
15	Metacetone		$C_6H_{10}O$	98.08
16	Metacrolein		$C_9H_{12}O$	136.10
17	Metacrylic acid		$CH_2:C:(CH_3)COOH$	86.05
18	Metaldehyde		$(C_2H_4O)_4$	176.13
19	Metanilic acid (m.)		$C_6H_4NH_2SO_3H$	173.13
20	Matastyrene		$(C_8H_8)x$	104.06
21	Methacetine	p-methoxy-acet-aminophenol	$CH_3O\cdot C_6H_4\cdot NH\cdot CO\cdot CH_3$	165.10
22	Methane	marsh gas	CH_4	16.03
23	Methenyldiphenyl-amine		$CH(C_6H_5N)C_6H_5NH$	196.11
24	Methoxybenzoic acid (o.)		$CH_3O\cdot C_6H_4\cdot COOH$	152.06
25	Methoxybenzoic acid (m.)		$CH_3O\cdot C_6H_4\cdot COOH$	152.06
26	Methoxypyridine (p.)		$C_2H_2\cdot C(OCH_3)\ CH_2:N$	97.06
27	Methoxyquinoline (p.)	quinanisol	$C_9H_6N(OCH_3)$	159.08
28	Methyl acetanilide		$CH_3CO\cdot N(CH_3)\cdot C_6H_5$	149.10
29	acetate		$CH_3\cdot COO\cdot CH_3$	74.05
30	aceto-acetate		$CH_3CO\cdot CH_2\cdot COO\cdot CH_3$	116.06
31	aceto-acetic ethic		$CH_3CO\cdot CH(CH_3)\cdot COO\cdot C_2H_5$	144.10
32	acetylurea		$CH_3NHCONH COCH_3$	116.08
33	acridine (2)		$CH_3\cdot C_{13}H_8N$	193.10
34	acrylate		$CH_3O_2\cdot CH_3$	62.05
35	acrylic acid		$CH_2:C(CH_3)\cdot COOH$	86.05
36	alcohol	wood alcohol	CH_3OH	32.03
37	alizarine		$C_6H_4(CO)_2\cdot C_6H\cdot CH_3(OH)_2$	254.08

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form and color	Sp. gr. $H_2O = 1$ (A)Air = 1	Melting-point °C	Boiling-point °C	Solubility in gms. per 100 c.c of		
					Water	Alcohol	Ether
1	liq.	2.444	.....	159	i.	sl. s.	s.
2	.....	.....	60	d.	.....	s.	.....
3	liq.	3.069	.....	96	i.	.....	.....
4	.....	1.944	243	.....	s. CS_2	sl. s. h.	s. chl.
5	rhomb.	2.32	120	.....	s. CS_2	sl. s. h.	s. chl.; s. bz.
6	colorl. need.	.....	202	subl.	2.7^{18}; v. s. h.	39	s.
7	liq.	0.9633	.....	229–30	.....	...	.....
8	cryst.	.....	68–9	219.5	i.	v. s.	v. s.
9	.....	$0.8568^{18°}$	.....	128.3	i.	∞	∞
10	colorl. liq.	$0.863^{20°}$	.....	164.5	i.	s.	s.
11	monocl.	.....	166	subl.	v. sl. s.	v. s.	.....
12	leaf.	.....	149–50	275	sl. s. c.	v. s.	v. s.
13	colorl. tab.	1.666	140–3	.....	$120^{16°}$	.....	.....
14	colorl. deliq. need.	119.20	.....	.....	v. s.	s.	s.
15	.....	$>H_2O$	8	.....	i.	.....	.....
16	cryst.	.....	50	170	i.	s.	s.
17	pr.	.....	16	160.5	s.	.....	.....
18	colorl. tetrag.	.....	subl. 112–6	.....	i.	$1.8^{70°}$	$0.5^{35°}$
19	need.	.....	.....	.....	1 : $68^{15°}$	.....	.....
20	vitreous	$1.054^{13°}$	d.	.....	i.	i.	v. sl. s.
21	colorl.	.....	127	.....	$2^{15°}$	$12.7^{21°}$	v. s. chl.
22	gas	0.558 (A)	−84	−164.7	5.45 c.c. 0°	52.2 c.c.	s.
23	need. f. al.	.....	136	>250	sl. s.	s.	s. bz.
24	monocl. tab.	1.180	98.5	.....	$0.5^{30°}$	.....	.....
25	colorl. need.	.....	167	subl.	sl. s.; v. s. h.	v. s.	v. s.
26	liq.	.....	.....	119.1^{738}	s.	.....	.....
27	.....	$1.665^{0°}$	.....	$186^{35mm.}$	.....	s.	.....
28	colorl. prisms	.....	102	245	s.	s.	.....
29	colorl. liq.	0.964	.....	57.5 (54)	$31.9^{20°}$	∞	∞
30	colorl. liq.	$1.037^{9°}$	.....	170	v. sl. s.	∞	∞
31	colorl. liq.	$1.009^{8°}$	.....	186.8	.....	s.	s.
32	monocl. pr.	.....	180	.....	sl. s. h.	sl. s.	sl. s.
33	yel'sh	.....	131.5–4.0	.....	v. s. bz.	v. s.	v. s.
34	colorl. liq.	$0.973^{0°}$	.....	80.3	.....	s.	s.
35	colorl. prisms	$0.015^{20°}$	14	162–3	s.	∞	∞
36	colorl. liq.	$0.7981^{15°}_{15°}$	−97.1	66	∞	∞	∞
37	or. need.	.....	250–2	subl. 200	s. acet.	s.	s.

PHYSICAL CONSTANTS OF

No.	Name	Synonyms	Formula	Mol. wt.
1	Methyl allene		$CH_2:C:CH\cdot CH_3$	54.05
2	allyl amine		$CH_3\cdot NH\cdot C_3H_5$	71.08
3	" carbinol		$CH_2:CH\cdot CH_2\cdot CH(OH)\cdot CH_3$	86.08
4	" ether		$CH_2\cdot O\cdot C_3H_5$	72.06
5	amine		CH_3NH_2	31.05
6	amine hydrochloride		$CH_3NH_2\cdot HCl$	67.51
7	amino-acetate		$NH_2\cdot CH_2\cdot COO\cdot CH_3$	89.06
8	" -benzoate (o.)		$NH_2\cdot C_6H_4\cdot COO\cdot CH_3$	151.08
9	" " (p.)		$NH_2\cdot C_6H_4\cdot COO\cdot CH_3$	151.08
10	" -propionic acid (α)		$CH_3\cdot CH(NHCH_3)\cdot COOH$	103.08
11	amyl ketone		$CH_3\cdot CO\cdot C_5H_{11}$	114.11
12	aniline		$C_6H_5\cdot NHCH_3$	107.07
13	anthracene (α)		$C_{14}H_9\cdot CH_3$	192.10
14	" (β)		$C_{14}H_9\cdot CH_3$	192.10
15	anthranilate		$H_2N\cdot C_6H_4\cdot COO\cdot CH_3$	151.08
16	anthraquinone (2)		$C_{14}H_7O_2\cdot CH_3$	222.08
17	arsenic acid		$AsOCH_3(OH)_2$	140.00
18	arsenious oxide		$AsOCH_3$	105.98
19	arsenic dichloride	dichlormethyl-arsine	$AsCl_2CH_3$	160.93
20	arsine		$CH_3\cdot AsH_2$	92.00
21	auramine		$CH_3N\cdot C\cdot[C_6H_4\cdot N(CH_3)_2]_2$	281.21
22	benzoate		$C_6H_5\cdot COO\cdot CH_3$	136.06
23	benzoyl-acetate		$C_6H_5CO\cdot CH_2\cdot COO\cdot CH_3$	178.08
24	benzyl-ketone		$CH_3\cdot CO\cdot CH_2C_6H_5$	134.08
25	bromide		CH_3Br	94.94
26	butyl amine		$CH_3\cdot NH\cdot C_4H_9$	87.11
27	" carbinol		$CH_3\cdot CH(OH)\cdot C_4H_9$	102.11
28	" ether		$CH_3\cdot O\cdot C_4H_9$	88.10
29	" ketone		$CH_3\cdot CO\cdot C_4H_9$	100.10
30	butyrate		$C_3H_7\cdot COO\cdot CH_3$	102.08
31	butyrone		$C_8H_{16}O$	128.13
32	caprate		$C_9H_{19}\cdot COO\cdot CH_3$	186.18
33	caproate		$C_5H_{11}\cdot COO\cdot CH_3$	130.11
34	caprylate		$C_7H_{15}\cdot COO\cdot CH_3$	158.14
35	carbamate		$NH_2\cdot COO\cdot CH_3$	75.05
36	carbanilide		$CH_3\cdot C_6H_5N\cdot CO\cdot NH\cdot C_6H_5$	226.13
37	carbostyril (γ)	lepidone	$C_9H_6(CH_3)ON$	159.08
38	chloracetate		$CH_2Cl\cdot COO\cdot CH_3$	108.52
39	chlorcarbonate		$Cl\cdot COO\cdot CH_3$	94.48
40	chloride	chloromethane	CH_3Cl	50.48
41	chloroform		CCl_3CH_3	133.40

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form and color	Sp. gr. $H_2O = 1$ (A)Air = 1	Melting-point °C	Boiling-point °C	Solubility in gms. per 100 c.c. of		
					Water	Alcohol	Ether
1	colorl. liq.	.....	.....	118–9	i.	∞	∞
2	colorl. liq.	.....	.....	65	∞	.....	.....
3	colorl. liq.	$0.834^{20°}$	.....	115–6	12.5	∞	∞
4	colorl. liq.	0.77	.....	46	v. sl. s.	∞	∞
5	gas	$0.699_{-10.8}$	.....	−6.7	$1150^{12°}$ c.c.	s.	.....
6	leaf.	.....	226–7	.....	v. s.	s.	i.
7	colorl. liq.	.....	.....	abt. 130 d.	.....	.....	.....
8	colorl.	1.168	24.5	.....	s.	v. s.	v. s.
9	colorl. leaf.	.....	112(102)	.....	.....	.....	.....
10	colorl. rhomb.	.....	260 d.	.....	s.	v. sl. s. c. abs.	.....
11	colorl. liq.	$0.835^{0°}$	.....	151	v. sl. s.	s.	s.
12	yell'w liq.	$0.987^{20°}$	.....	195.5	v. sl. s.	s.	∞
13	colorl. leaf.	.....	199–200	.....	s. bz.	..,...	.....
14	colorl. scales	.....	199–200 (207)	.....	s. bz.	sl. s.	sl. s.
15	.....	1.168	24.5	.....	sl. s.	v. s.	v. s.
16	yel'sh need.	.....	177	subl.	v. s. bz.	v. sl. s.	s.
17	pl.	.....	.....	.....	s.	s.	.....
18	pr.	.....	95	d.	.....	.....	.....
19	.....	.....	.....	133	.....	.....	.....
20	gas	.....	.....	2	.....	v. s.	v. s.
21	gr'n'sh yel.	.....	130–3	.....	v. sl. s.	v. s.	.....
22	colorl. liq.	1.094	−12.3	199	v. sl. s.	∞	∞
23	colorl. liq.	.....	.....	260–5 d.	i.	∞	∞
24	colorl.	$1.019^{0°}$	27	215	i.	v. s.	v. s.
25	gas	$1.732^{0°}$	<−84	4.5	sl. s.	v. s.	v. s.
26	colorl. liq.	0.737	.....	91	.....	.....	.....
27	colorl. liq.	$0.833^{0°}$	.....	136	v. sl. s.	s.	.....
28	colorl. liq.	$0.763^{0°}$	.....	70.3	v. sl. s.	∞	∞
29	colorl. liq.	$0.830^{0°}$	.....	127	v. sl. s.	∞	∞
30	colorl. liq.	$0.919^{0°}$	.....	102.3	s.	∞	∞
31	colorl. liq.	0.827	.....	180	i.	v. s.	v. s.
32	colorl. liq.	.....	.....	223.5	i.	v. s.	v. s.
33	colorl. liq.	$0.904^{0°}$	.....	150	i.	v. s.	v. s.
34	colorl. liq.	$0.894^{0°}$	.....	193	i.	v. s.	v. s.
35	colorl. tab.	.....	52	177	$217^{11°}$	$73^{15°}$	s.
36	colorl. need.	.....	104	.....	i.	sl. s.	v. s.
37	colorl. need.	.....	217.4	.....	v. sl. s. c.	v. s. h.	v. sl. s.
38	colorl. liq.	.....	.....	130–2	v. sl. s.	∞	∞
39	colorl. liq.	.....	.....	72–5	dec.	∞	∞
40	colorl. gas	0.920	−91.5	−23.7	400 c.c.	3500 c.c.	.....
41	.....	$1.346^{0°}$	.....	74.1	.....	.....	.....

No.	Name	Synonyms	Formula	Mol. wt.
1	Methyl cinnamate		$C_6H_5{\cdot}CH : CH{\cdot}COOCH_3$	162.08
2	cotonate (α)		$C_3H_5{\cdot}COO{\cdot}CH_3$	100.06
3	coumarin		$C_6H_4{\cdot}C(CH_3) : CH{\cdot}COO$	160.06
4	cyan-acetate		$CH_2(CN){\cdot}COOCH_3$	99.05
5	cyanide	acetonitrile	$CH_3{\cdot}CN$	41.03
6	diazoamino-benzene (4)		$CH_3{\cdot}C_6H_4{\cdot}N_2{\cdot}NH{\cdot}C_6H_5$	211.13
7	diethyl amine		$CH_3N(C_2H_5)_2$	87.11
8	diethyl amino-benzene (o.)		$CH_3{\cdot}C_6H_4{\cdot}N(C_2H_5)_2$	163.14
9	diethyl amino-benzene (p.)		$CH_3{\cdot}C_6H_4{\cdot}N(C_2H_5)_2$	163.14
10	diethyl carbinol		$(C_2H_5)_2{\cdot}C(OH){\cdot}CH_3$	102.11
11	diphenylamine		$(C_6H_5)_2NCH_3$	183.11
12	ether		$CH_3{\cdot}O{\cdot}CH_3$	46.05
13	ethyl acetic acid		$CH_3{\cdot}CH(C_2H_5){\cdot}COOH$	102.08
	" acetone		$CH_3{\cdot}CO{\cdot}CH(C_2H_5){\cdot}CH_3$	100.10
15	" aniline		$C_6H_5{\cdot}N(CH_3)C_2H_5$	135.11
16	" benzene (o.)		$CH_3{\cdot}C_6H_4{\cdot}C_2H_5$	120.10
17	" " (m.)		$CH_3{\cdot}C_6H_4{\cdot}C_2H_5$	120.10
18	" " (p.)		$CH_3{\cdot}C_6H_4{\cdot}C_2H_5$	120.10
19	" carbonate		$CH_3{\cdot}CO_3{\cdot}C_2H_5$	104.06
20	" ether		$CH_3{\cdot}O{\cdot}C_2H_5$	60.06
21	" ketone		$CH_3{\cdot}CO{\cdot}C_2H_5$	72.06
22	" ketoxime		$CH_3{\cdot}C(NOH){\cdot}C_2H_5$	87.08
23	" oxalate		$CH_3{\cdot}OOC{\cdot}COO{\cdot}C_2H_5$	132.06
24	" protocatechuic aldehyde ethyl succinate		$C_6H_3(CHO)(OCH_3)(OC_2H_5)$	180.10
25	" sulfide		$C_7H_{12}O_4$	160.10
26	formate		$CH_3{\cdot}S{\cdot}C_2H_5$	76.13
27	furfurane		$H{\cdot}COO{\cdot}CH_3$	60.03
28	furfurol		$C_4H_3O(CH_3)$	82.05
29	glycerate		$CH_3{\cdot}C_4H_2O{\cdot}CHO$	110.05
30	glycolate		$CH_2OH{\cdot}CHOH{\cdot}COO{\cdot}CH_3$	120.06
31	glyoxaline		$CH_2(OH){\cdot}COO{\cdot}CH_3$	90.05
32	heptenone		$C_3H_3N_2CH_3$	82.06
33	heptyl ether		$(CH_3)_2C : CH(CH_2)_2{\cdot}COCH_3$	126.11
34	hexyl carbinol		$CH_3{\cdot}O{\cdot}C_7H_{15}$	130.14
35	hexyl ketone		$CH_3(CH_2)_5CHOH{\cdot}CH_3$	130.14
36	hydantoin (β)		$CH_3{\cdot}CO{\cdot}C_6H_{13}$	128.13
37	hydrazine		$C_4H_6N_2O_2$	114.06
38	hydrazo-benzene (o.)		$NH_2{\cdot}NH{\cdot}CH_3$	46.06
39	hydrazo-benzene (m.)		$CH_3{\cdot}C_6H_4{\cdot}NH{\cdot}NH{\cdot}C_6H_5$	198.13
40			$CH_3{\cdot}C_6H_4{\cdot}NH{\cdot}NH{\cdot}C_6H_5$	198.13

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form and color	Sp. gr. $H_2O = 1$ (A) Air = 1	Melting-point °C	Boiling-point °C	Solubility in gms. per 100 c.c. of		
					Water	Alcohol	Ether
1	colorl.	$1.042^{36°}$	36	260	i.	v. s.	s.
2	colorl. liq.	$0.9814^{0°}$	.....	120.7	i.	v. s.	v. s.
3	need.	.....	126	.....	.....	s.	s. bz.
4	colorl. liq.	.....	−22.5	204	i.	∞	∞
5	colorl. liq.	0.791	−41	81.5	∞	∞	.....
6	yel'shleaf.	.....	90–1	.....	.....	.....	.....
7	colorl. liq.	.....	.....	63–5	v. s.	.....	.....
8	colorl. liq.	.....	.....	227–8	.....	.....	.....
9	colorl. liq.	0.924	.....	229	.....	.....	.....
10	colorl. liq.	$0.824^{20°}$	.....	123	sl. s.	s.	.....
11	colorl. liq.	$1.052^{15°}_{4°}$	.....	296	i.	.....	.....
12	colorl. gas	.....	−138.5	−34	3700 c.c.	v. s.	v. s.
13	colorl. liq.	$0.938^{20°}_{20°}$	<−80	177	sl. s.	∞	∞
14	colorl. liq.	0.818	.....	118	sl. s.	∞	∞
15	colorl. liq.	.....	.....	201	.....	.....	.....
16	colorl. liq.	0.873	.....	158–9	i.	s.	s.
17	colorl. liq.	$0.860^{20°}$	.....	158–9	i.	s.	s.
18	colorl. liq.	0.865	.....	162	i.	s.	s.
19	colorl. liq.	$1.002^{27°}$	−14.5	109.2	i.	∞	∞
20	colorl. liq.	$0.725^{0°}$	.....	10.8	s.	∞	∞
21	colorl. liq.	$0.805^{20°}$	.....	80.6	s.	∞	s.
22	colorl. liq.	$0.919^{24°}$	.....	152–3	10	∞	∞
23	colorl. liq.	$1.156^{0°}$	.....	173.8	i.	v. s.	v. s.
24	pr.	.....	73–4	subl.	sl. s. h.	sl. s.	s.
25	colorl. liq.	$1.093^{0°}$	.....	208.2	i.	v. s.	v. s.
26	liq.	.....	−105	70	i.	∞	∞
27	colorl. liq.	0.980	.....	32.3	$30.4^{20°}$	∞	.....
28	.....	.....	.....	63	.....	.....	.....
29	colorl. liq.	1.109	.....	187	3.3	v. s.	.....
30	liq.	.....	.....	239–44	∞	∞	v. sl. s.
31	colorl. liq.	$1.168^{18°}$	.....	151.2	.....	.....	.....
32	.....	$1.036^{10°}$	−6	197–9	∞	.....	.....
33	colorl. liq.	0.855	.....	173–4 (170)	i.	∞	∞
34	colorl. liq.	$0.795^{0°}$	.....	149.8	i.	∞	∞
35	.....	$0.823^{16°}$	.....	179.5	.....	.....	.....
36	colorl. liq.	0.820	−16	172.5	i.	∞	∞
37	pr.	.....	157–8	subl.	s.	s.	.....
38	colorl. liq.	.....	.....	87.5	v. s.	∞	∞
39	colorl. leaf.	.....	101–2	.....	i.	.....	.....
40	colorl. prisms f. lgr.	.....	59–61	.....	.....	v. s.	.....

PHYSICAL CONSTANTS OF

No.	Name	Synonyms	Formula	Mol. wt.
1	Methyl-hydrazo-benzene (p.)	.....	$CH_3 \cdot C_6H_4 \cdot NH \cdot NH \cdot C_6H_5$	198.12
2	hydrogen sulfate	methyl sulfuric acid	$CH_3 \cdot HSO_4$	112.10
3	hydroxylamine (β)	.....	CH_3NHOH	47.05
4	iodide	iodomethane	CH_3I	141.96
5	isatin (p.)	.....	$C_6H_4 \cdot N : C(OCH_3)CO$	161.06
6	isoamyl ketone .	.....	$CH_3 \cdot CO \cdot C_5H_{11}$	114.11
7	" ketoxime	.....	$CH_3 \cdot C(NOH) \cdot C_5H_{11}$	129.13
8	isobutyl amine ..	.....	$CH_3 \cdot NH \cdot C_4H_9$	87.11
9	" ketone .	.....	$CH_3 \cdot CO \cdot C_4H_9$	100.10
10	isobutyrate	.....	$(CH_3)_2 \cdot CH \cdot COO \cdot CH_3$	102.08
11	isocyanide	methyl carbyl-amine	$CH_3 \cdot NC$	41.03
12	isopropyl benzene (m.)	.....	$CH_3 \cdot C_6H_4CH(CH_3)_2$	134.11
13	" (p.)	See *cymene*		
14	" ketone	.....	$CH_3 \cdot CO \cdot CH(CH_3)_2$	86.08
15	" ketoxime	.....	$CH_3 \cdot C(NOH) \cdot CH(CH_3)_2$	101.10
16	isosuccinate	.....	$CH_3 \cdot CH \cdot (COO \cdot CH_3)_2$	146.08
17	isovaleriate	.....	$C_4H_9 \cdot COO \cdot CH_3$	116.10
18	lactate	.....	$CH_3 \cdot CH(OH) \cdot COO \cdot CH_3$	104.06
19	malate	.....	$C_2H_4O \cdot (COO \cdot CH_3)_2$	162.08
20	malonate	.....	$CH_2 \cdot (COO \cdot CH_3)_2$ ..	132.06
21	mercaptan	.....	$CH_3 \cdot SH$	48.10
22	mustard oil	methyl isothio-cyanate	$CH_3 \cdot NCS$	73.10
23	naphthalene (α)	.....	$C_{10}H_7 \cdot CH_3$	142.08
24	" (β)	.....	$C_{10}H_7 \cdot CH_3$	142.08
25	naphthylamine (α)	.....	$C_{10}H_7 \cdot NHCH_3$	157.10
26	" (β)	.....	$C_{10}H_7 \cdot NHCH_3$	157.10
27	naphthyl ether (α)	.....	$C_{10}H_7 \cdot O \cdot CH_3$	158.08
28	" " (β)	nerolin	$C_{10}H_7 \cdot O \cdot CH_3$	158.08
29	nitrate	.....	$CH_3 \cdot NO_3$	77.03
30	nitrite	.....	$CH_3 \cdot NO_2$	61.03
31	nitrobenzoate (o.)	.....	$NO_2 \cdot C_6H_4 \cdot COO \cdot CH_3$	181.06
32	" (m.)	.....	$NO_2 \cdot C_6H_4 \cdot COO \cdot CH_3$	181.06
33	" (p.)	.....	$NO_2 \cdot C_6H_4 \cdot COO \cdot CH_3$	181.06
34	nitrolic acid	.....	$HC(NOH)NO_2$	90.03
35	nonyl ketone ...	.....	$CH_3 \cdot CO \cdot C_9H_{19}$	170.13

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form and color	Sp. gr. $H_2O = 1$ (A)Air = 1	Melting-point °C	Boiling-point °C	Solubility in gms. per 100 c.c. of		
					Water	Alcohol	Ether
1	colorl. scales	.....	86–7	.....	.....	v. s.	v. s. bz.
2	oil	.....	<−30	.....	v. s.	s.	s.
3	.....	.....	42	$62^{15mm.}$	.....	.....	.....
4	colorl.-br. liq.	2.285	.....	42.5 (45)	$1.4^{20°}$	∞	∞
5	red. cryst.	.....	187	.....	sl. s. c.	s. alk.	.....
6	colorl. liq.	$0.818^{17°}$	.....	144	v. sl. s.	∞	∞
7	colorl. yel.	$0.888^{20°}$	.....	195–6 d.	.....	.....	.....
8	colorl. liq.	.....	.....	76–8	.....	.....	.....
9	colorl. liq.	$0.803^{19°}$	.....	116 (119)	i.	∞	∞
10	colorl. liq.	$0.912^{0°}$	.....	92.3	sl. s.	∞	∞
11	colorl. liq.	$0.756^{4°}$	.....	59.6	$10^{15°}$	s.	∞
12	colorl. liq.	$0.862^{20°}$	.....	175–6	.....	.....	.....
13							
14	colorl. liq.	0.805	.....	95	v. sl. s.	∞	∞
15	colorl. liq.	.....	.....	157–8	.....	.....	.....
16	colorl. liq.	1.107	.....	179	v. sl. s.	∞	∞
17	colorl. liq.	$0.901^{9°}$	.....	116.7	v. sl. s.	∞	∞
18	colorl. liq.	1.094	.....	144.8	s., d.	s.	s.
19	colorl. liq.	.....	.....	242–6	v. s.	∞	∞
20	colorl. liq.	1.160	−62	181.5	v. sl. s.	∞	∞
21	gas	.....	−130.5	5.8	i.	v. s.	v. s.
22	.....	$1.069^{37°}$	35	119	v. sl. s.	∞	v. s.
23	colorl. liq.	$1.001^{19°}$	−22	240–2	i.	v. s.	v. s.
24	colorl. monocl.	.....	32.5	242	i.	v. s.	v. s.
25	red oil	.....	.....	293	i.	v. s.	v. s.
26	darkens in air	.....	.....	298	.....	.....	.....
27	colorl. liq.	1.096	.....	269	i.	v. s.	v. s.
28	colorl. leaf.	.....	72	274	sl. s.	sl. s.	v. s.
29	liq.	$1.182^{22°}$	.....	55–6, exp.	sl. s.	s.	s.
30	gas.....	0.991	.....	−12	.....	s.	s.
31	yel. oil	$1.286^{20°}$	−13	275 (286–9)	i.	∞	∞
32	.....	.....	78.5 (70)	279	.....	sl. s. methyl	.....
33	yel. leaf.	.....	96	.....	i.	s.	s.
34	need.	.....	64	.....	v. s.	.....	v.s.
35	colorl.	$0.829^{18°}$	15 *	224 (230)	i.	s.	s.

* Solidifies at 6° C

No.	Name	Synonym	Formula	Mol. wt.
1	Methyl-orange	Na salt of helianthine	$(CH_3)_2N \cdot C_6H_4 \cdot N_2 \cdot C_6H_4 \cdot SO_3Na$	327.20
2	oxalate		$(CH_3O_2C)_2$	118.05
3	palmitate		$C_{16}H_{31} \cdot COOCH_3$	270.27
4	phenazine		$C_6H_4 : N_2 : C_6H_3(CH_3)$	194.10
5	phenyl acetate		$C_6H_5 \cdot CH_2 \cdot COO \cdot CH_3$	150.08
6	" carbinol		$CH_3 \cdot CH(OH) \cdot C_6H_5$	122.08
7	" ether	See *anisol*		
8	phosphine		$CH_3 \cdot PH_2$	48.07
9	phosphoric acid		$CH_3PO(OH)_2$	96.07
10	phthalate. See	*dimethyl phthalate*		
11	piperidine (α)	pipecolin	$CH_3 \cdot C_5H_9NH$	99.11
12	" (β)		$CH_3 \cdot C_5H_9NH$	99.11
13	" (γ)		$CH_3 \cdot C_5H_9NH$	99.11
14	propargyl ether		$CH_3 \cdot O \cdot C_3H_3$	70.05
15	propionate		$C_2H_5 \cdot COO \cdot CH_3$	88.06
16	propyl acetic acid		$CH_3 \cdot CH(C_3H_7) \cdot COOH$	116.10
17	" amine		$CH_3 \cdot NH \cdot C_3H_7$	73.10
18	" benzene (o.)		$C_6H_4(CH_3)C_3H_7$	134.11
19	" " (m.)		$C_6H_4(CH_3)C_3H_7$	134.11
20	" ether		$CH_3 \cdot O \cdot C_3H_7$	74.08
21	" ketone		$CH_3 \cdot CO \cdot C_3H_7$	86.08
22	" ketoxime		$CH_3 \cdot C(NOH) \cdot C_3H_7$	101.10
23	pseudoisatin		$C_6H_4N(CH_3)CO \cdot CO$	161.06
24	pyridine.	See *picoline*		
25	pyrogallol		$C_6H_2(CH_3)(OH)_3$	140.06
26	pyrrol (1)		$C_4H_4N \cdot CH_3$	81.06
27	" (2)		$C_4H_4N \cdot CH_3$	81.06
28	pyruviate		$C_3H_3O_3 \cdot CH_3$	102.05
29	quinoline (2)	quinaldine	$CH_3 \cdot C_9H_6N$	143.08
30	salicylate	artificial oil of wintergreen	$HO \cdot C_6H_4 \cdot COO \cdot CH_3$	152.06
31	stearate		$C_{17}H_{35} \cdot COO \cdot CH_3$	298.30
32	succinate		$C_2H_4(COOCH_3)_2$	146.08
33	succinic acid		$CH_3 \cdot CH(COOH) \cdot CH_2 \cdot COOH$	132.06
34	sulfate		$(CH_3)_2 \cdot SO_4$	126.11
35	sulfide		$(CH_3)_2 \cdot S$	62.11
36	sulfite		$(CH_3)_2 \cdot SO_3$	110.11
37	sulfocyanate	methyl thiocyanate	$CH_3 \cdot SCN$	73.10
38	sulfonic acid		$CH_3 \cdot HSO_3$	96.10
39	" chloride		CH_3SO_2Cl	114.54
40	tartrate. See	*dimethyl tartrate*		
41	tetramethylene		C_5H_{10}	70.08
42	thiocarbamide	methylthiourea	$CS(NH_2)(NHCH_3)$	90.13
43	trichlor-acetate		$CCl_3 \cdot COO \cdot CH_3$	177.45
44	trimethyl acetate		$(CH_3)_3C \cdot COO \cdot CH_3$	116.10
45	trimethylene		C_4H_8	56.06

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form and color	Sp. gr. $H_2O = 1$ (A)Air = 1	Melting-point °C	Boiling-point °C	Solubility in gms. per 100 c.c. of		
					Water	Alcohol	Ether
1	yel. powd.	.....	.....	....	v. s.	s.	i.
2	monocl. tab.	$1.1479^{54°}$	54	63.3	sl. s.	s.	s. meth. al.
3	colorl.	.....	28	.....	i.	s.	s.
4	need.	.....	117	350 d.	sl. s. h.	sl. s.	sl. s.
5	colorl. liq.	1.044	.....	220	i.	∞	∞
6	colorl. liq.	.....	.....	202–4	i.	∞	∞
7							
8	gas	.....	.....	−14	sl. s.	sl. s.	v. s.
9	.....	.....	105	.....	.....	.....	.....
10							
11	liq.	$0.86^{0°}$	.....	118–9	s.	.....	.....
12	liq.	$0.8684^{0°}$	.....	124–6	v. s.	.....	.....
13	liq.	$0.8674^{0°}$	.....	126–9	s.	.....	.....
14	colorl. liq.	0.83	.....	61–2	sl. s.	∞	∞
15	colorl. liq.	$0.915^{20°}$	<−75	79.9	$6.5^{20°}$	∞	∞
16	colorl .liq.	$0.941^{0°}$	.....	193	$0.57^{17°}$	s.	s.
17	colorl. liq.	$0.720^{17°}$	.....	62–4	s.	.....	.....
18	liq.	.....	.....	181–2	i.	s.	.....
19	liq.	$0.863^{18°}$	.....	176–7	i.	s.	.....
20	colorl. liq.	$0.746^{20°}$	.....	38.9	s.	∞	∞
21	colorl. liq.	0.812	.....	102	v. sl. s.	∞	∞
22	colorl. liq.	$0.907^{20°}$	.....	168	s.	∞	∞
23	red. need.	.....	134	.....	.....	.....	.....
24							
25	cryst.	.....	129	.....	.....	.....	.....
26	colorl. liq.	0.915	.....	114–5	i.	∞	∞
27	.....	$0.9446^{15°}_{4°}$	.....	147–8 ^{750mm}	.....	.....	.....
28	colorl. liq.	$1.154^{0°}$	.....	134–7	.....	∞	∞
29	colorl. liq.	.....	.....	246–7	v. sl. s.	.....	.....
30	colorl. liq.	1.186	−8.3	224	sl. s.	∞	∞
31	colorl.	.....	38	.....	i.	s.	s.
32	cryst.	$1.1208^{20°}_{4°}$	18.5	195.3	.....	.....	.....
33	sm. need.	1.410	112	d.	1 : 15	s.	s.
34	colorl. liq.	1.352^{-0}	−10	188.3–.6	v. sl. s.	.....	s.
35	colorl. liq.	$0.846^{21°}$	−83	38	i.	s.	s.
36	colorl. liq.	1.046	.....	121.5	dec.	s.	s.
37	colorl. liq.	$1.069^{24°}$	−51	133	i.	∞	∞
38	colorl. liq.	.....	.....	d. 130	v. s.	.....	.....
39	.....	1.51	.....	160	i.	s.	s.
40							
41	colorl. liq.	.....	.....	39–40	i.	∞	∞
42	pr.	.....	118	.....	s.	s.	sl. s.
43	colorl.	$1.673^{35°}$	34	191–2	dec.	dec. ∞	s. ∞
44	colorl. liq.	$1.044^{0°}$	.....	101	.....		
45	gas	.....	.....	4–5	sl. s.	v. s.	v. s.

PHYSICAL CONSTANTS OF

No.	Name	Synonyms	Formula	Mol. wt.
1	Methyl-uracyl		$CH_3 \cdot C{:}\,CHCONHCONH$	126.06
2	urea		$NH_2 \cdot CO \cdot NHCH_3$	74.06
3	uric acid (1)		$C_6H_6O_3N_4$	182.08
4	" " (3)		$C_6H_6O_3N_4 + \frac{1}{2}H_2O$	191.09
5	" " (7)		$C_6H_6O_3N_4 + H_2O$	200.10
6	valeriate		$C_4H_9 \cdot COO \cdot CH_3$	116.10
7	Methylal		$CH_2 \cdot (OCH_3)_2$	76.06
8	Methylene acetate		$(CH_3 \cdot COO)_2CH_2$	132.06
9	bromide	dibrom-methane	CH_2Br_2	173.85
10	chloride	dichlor-methane	CH_2Cl_2	84.95
11	disulfonic acid		$CH_2(SO_3H)_2$	176.16
12	iodide	diiodo methane	CH_2I_2	267.88
13	Michler's ketone.	See *tetramethyldiaminobenzophenone* (4, 4′)		
14	Milk sugar.	See *lactose*		
15	Monacetin (α)	glyceryl monacetate	$CH_2(OH) \cdot CH(OH) \cdot CH_2 \cdot OOC \cdot CH_3$	134.08
16	Morin	tetrahydroxy-flavanol	$C_{15}H_{10}O_7 + 2H_2O$	338.11
17	Morphine		$C_{17}H_{19}O_3N + H_2O$	303.18
18	hydrochloride		$C_{17}H_{19}O_3N \cdot HCl + 3H_2O$	375.68
19	sulphate		$(C_{17}H_{19}O_3N)_2H_2SO_4 + 5H_2O$	758.48
20	Mucic acid		$COOH \cdot (CHOH)_4 \cdot COOH$	210.08
21	Muconic acid		$C_6H_6O_4$	142.05
22	Murexide	NH_4 salt of purpuric acid	$C_8H_4O_6N_5 \cdot NH_4 + H_2O$	302.13
23	Mustard oil acetic acid		$CSN \cdot CH_2 \cdot COOH$	117.10
24	Myricyl alcohol		$C_{30}H_{61} \cdot OH$	438.50
25	Myristic acid		$C_{13}H_{27} \cdot COOH$	228.22
26	Myristine	trimyristine	$(C_{14}H_{27}O_2)_3C_3H_5$	722.69
27	Naphthalene		$C_{10}H_8$	128.06
28	dicarboxylic acid (α)		$C_{10}H_6(COOH)_2$	216.06
29	" " (β)		$C_{10}H_6(COOH)_2$	216.06
30	disulfonic acid (2, 6)		$C_{10}H_6(SO_3H)_2$	288.19
31	disulfonic acid (2, 7)		$C_{10}H_6 \cdot (SO_3H)_2$	288.19
32	sulfonic acid (α)		$C_{10}H_7 \cdot SO_3H + H_2O$	226.14

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form and color	Sp. gr. H_2O = 1 (A)Air = 1	Melting-point °C	Boiling-point °C	Solubility in gms. per 100 c.c. of		
					Water	Alcohol	Ether
1	need.	.....	.....	....	sl. s.	sl. s.	v. sl. s.
2	colorl. prisms	.....	102	dec.	v. s.	v. s.	sl. s.
3	colorl. need.	.....	d. 400	.....	$0.05^{100°}$	.....	.....
4	colorl. pr. f. w.	.....	d. 360	.....	$0.38^{100°}$	v. sl. s.	s. alk.
5	colorl. leaf. f. w.	.....	d. 370–80	.....	$1.25^{100°}$	s. alk.	.....
6	colorl. liq.	0.910°	.....	127.3	v. sl. s.	∞	∞
7	colorl. liq.	0.872	.....	45.5	v. s.	∞	∞
8	colorl. liq.	.....	.....	170	.....	∞	∞
9	liq.	2.498	.....	97	$1.15^{20°}$	∞	∞
10	colorl. liq.	1.377	.....	42	$2^{20°}$	∞	∞
11	need.	.....	.....	.....	deliq.	.....	.....
12	yel. liq.	3.333	4	180 d.	i.	∞	∞
13							
14							
15	colorl. liq.	1.221	.....	dec.	v. s.	v. s.	sl. s.
16	colorl. need.	.....	285	.....	1: 4000	s.	s. acet. s.
17	colorl. need.	1.32	230 d.	.....	0.03	0.6	0.02
18	need.	.....	.....	.....	1.72	2.38	i.
19	need.	.....	d. 250	.....	6.66	0.22	i.
20	colorl. cryst. powd.	.....	206 d.	.....	$0.33^{14°}$	i.	.....
21	.....	.....	100	.....	s.	s.	s.
22	purp. powd.	.....	.....	.....	s.	i.	i.
23	rhomb. pl.	.....	125–6	subl.	s. h.	.....	.....
24	colorl. need. f. eth.	.....	85	.....	i.	s.	s.
25	colorl. leaf.	.....	53.8	250.5 ^{100mm}	i.	v. sl. s.	v. sl. s.
26	glit. need. f. eth.	.....	55	.....	.....	.....	s.
27	colorl. monocl.	1.152	80	218	i.	5.3 abs.	v. s.
28	need. f. al.	.....	>300	.....	.....	sl. s. h.	.....
29	long. need. f. al.	.....	d.	.....	.....	.....	.....
30	need.	.....	.....	.....	v. s.	s.	i.
31	leaf.	....	.....	.....	v. s.	s.	i.
32	.....	.....	90	.....	s.	s.	sl. s.

No.	Name	Synonyms	Formula	Mol. wt.
1	Naphthalene sulfonic acid (β)	.....	$C_{10}H_7 \cdot SO_3H$	208.13
2	sulfonic chloride (α)	.....	$C_{10}H_7 \cdot SO_2 \cdot Cl$	226.57
3	" " (β)	.....	$C_{10}H_7 \cdot SO_2 \cdot Cl$	226.57
4	Naphthalic acid (1, 8)	.....	$C_{10}H_6 \cdot (COOH)_2$	216.06
5	Naphthamide (α)	.....	$C_{10}H_7 \cdot CO \cdot NH_2$	171.08
6	" (β)	.....	$C_{10}H_7 \cdot CO \cdot NH_2$	171.08
7	Naphthazarin (7 8–1, 4)	dihydroxy-α-naphtho-quinone	$C_{10}H_4(OH)_2O_2$	190.05
8	Naphthionic acid.	α^1, α^2-naphthylamine-sulfonic acid	$C_{10}H_6NH_2SO_3H$	223.14
9	Naphthoic acid (α)	.....	$C_{10}H_7 \cdot COOH$	172.06
10	" " (β)	.....	$C_{10}H_7 \cdot COOH$	172.06
11	aldehyde (α) ...	.....	$C_{10}H_7 \cdot CHO$	156.06
12	" (β)	.....	$C_{10}H_7 \cdot CHO$	156.06
13	Naphthol (α)	.....	$C_{10}H_7 \cdot OH$	144.06
14	" (β)	.....	$C_{10}H_7 \cdot OH$	144.06
15	" acetate (α)	.....	$C_{10}H_7OC_2H_3O$	186.08
16	" " (β)	.....	$C_{10}H_7OC_2H_3O$	186.08
17	Naphtholethyl ether (α)	.....	$C_{10}H_7OC_2H_5$	172.10
18	Naphtholethyl ether (β)	neroline	$C_{10}H_7OC_2H_5$	172.10
19	Naphtholmethyl ether (α)	.....	$C_{10}H_7OCH_3$	158.08
20	Naphtholmethyl ether (β)	.....	$C_{10}H_7OCH_3$	158.08
21	Naphtholnaphthyl ether (β)	.....	$(C_{10}H_7)_2O$	270.11
22	Naphthol sulfonic acid (1, 4)	.....	$C_{10}H_6(OH)SO_3H$	224.13
23	Naphthol sulfonic acid (1, 5)	.....	$C_{10}H_6(OH)SO_3H$	224.13
24	Naphthol sulfonic acid (1, 8)	.....	$C_{10}H_6(OH)SO_3H + H_2O$	242.14
25	Naphthol sulfonic acid (1, 2), (α)	.....	$C_{10}H_6(OH)SO_3H$	224.13
26	Naphthol sulfonic acid (2, 3)	.....	$C_{10}H_6(OH)SO_3H$	224.13
27	Naphthol sulfonic acid (2, 6), (β)	.....	$C_{10}H_6(OH)SO_3H$	224.13
28	Naphthonitrile (α)	naphthyl cyanide	$C_{10}H_7 \cdot CN$	153.06
29	" (β)	" "	$C_{10}H_7 \cdot CN$	153.06

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form and color	Sp. gr. $H_2O = 1$ (A)Air = 1	Melting-point °C	Boiling-point °C	Solubility in gms. per 100 c.c. of		
					Water	Alcohol	Ether
1	leaf.	.....	161	.....	s.	.....	.....
2	tab.	.....	67	.....	i.	s.	v. s.
3	tab.	.....	77	.....	i.	s.	v. s.
4	colorl. need. f. al.	.....	*	.....	v. sl. s.	sl. s.	sl. s.
5	colorl. f. al.	.....	202	.....	v. sl. s.	v. sl. s.	.....
6	colorl. tab.	.....	192	.....	sl. s.	sl. s.	.....
7	red br. need. f. al.	.....	subl.	.....	sl. s. h.	s.	s. alk.
8	sm. need. f. w.	.....	d.	.....	1: 4030 $^{15°}$	v. sl. s.	i.
9	colorl. need.	.....	160	300	v. sl. s. h.	v. s. h.	s.
10	colorl. need.	.....	184	>300	v. sl. s. h.	v. s.	v. s.
11	liq.	.....	.....	292	i.	s.	s.
12	colorl. leaf. f. w.	.....	61	.....	s. h.	v. s.	v. s.
13	colorl. monocl.	1.224$^{4°}$...	94	278–80	sl. s. h.; i. c.	v. s.	v. s.
14	colorl. leaf.	1.217$^{4°}$	122	285–6	sl. s. h.	v. s.	v. s.
15	need. or pl. f. al.	.....	.....	.....	d. on boil.	s.	v. s.
16	sm. need.	.....	70	.....	i.	s.	s.
17	liq.	.....	.....	272	.....	.....	.....
18	cryst.	.....	33	274–5	.....	.....	.....
19	liq.	.....	.....	263	.....	.....	.....
20	sm. leaf. f. eth.	.....	70	274	sl. s.	sl. s.	v. s.
21	colorl. leaf.	.....	subl.	.....	i.	s. h.	v. s.
22	colorl. pl.	.....	170 d.	.....	v. s.	.....	.....
23	cryst.	.....	110–20	.....	s.	.....	.....
24	cryst.	.....	107	180 anh.	v. s.	.....	.....
25	colorl. tab.	.....	>250	.....	s.	.....	.....
26	leaf.	.....	125	.....	v. s.	s.	.....
27	colorl. leaf.	.....	122	.....	v. s.	v. s.	.....
28	colorl. need.	1.117$\frac{15}{15}$°	37.5	299	i.	v. s.	v. s.
29	colorl. leaf.	1.094$\frac{20}{20}$°	66	304–5	i.	s.	s.

* The anhydride forms at 150° C.; this melts at about 270° C.

PHYSICAL CONSTANTS OF

No.	Name	Synonyms	Formula	Mol. wt.
1	Naphthophenazine (α, β)	.....	$C_{10}H_6$: N_2: C_6H_4 ...	230.10
2	Naphthoquinaldine (α)	.....	$C_{13}H_8NCH_3$.....	193.10
3	" (β)	.....	$C_{13}H_8NCH_3$.....	193.10
4	Naphthoquinoline (α)	.....	$C_{13}H_9N$.....	179.08
5	" (β)	.....	$C_{13}H_9N$.....	179.08
6	Naphthoquinone (α)	.....	$C_{10}H_6O_2$.....	158.07
7	" (β)	.....	$C_{10}H_6O_2$.....	158.07
8	Naphthosalol....	betol.....	$C_{10}H_7OCOC_6H_4(OH)$	264.10
9	Naphthosulfone..	.....	$C_{10}H_6OSO_2$.....	206.11
10	Naphthyl acetate (α)	.....	$CH_3 \cdot COO \cdot C_{10}H_7$...	186.08
11	" " (β)	.....	$CH_3 \cdot COO \cdot C_{10}H_7$...	186.08
12	amine (α).....	.....	$C_{10}H_7 \cdot NH_2$.....	143.08
13	" hydrochloride (α)	.....	$C_{10}H_7 \cdot NH_2 \cdot HCl$...	179.55
14	" (β).....	.....	$C_{10}H_7 \cdot NH_2$.....	143.08
15	" hydrochloride (β)	.....	$C_{10}H_7 \cdot NH_2 \cdot HCl$...	179.55
16	" sulfonic acid (1, 4)	naphthionic acid..	$NH_2 \cdot C_{10}H_6 \cdot SO_3H + \frac{1}{2}H_2O$	232.20
17	cyanide.	See *naphtho-nitrile*		
18	ether (α).....	.....	$C_{10}H_7 \cdot O \cdot C_{10}H_7$....	270.11
19	" (β).....	.....	$C_{10}H_7 \cdot O \cdot C_{10}H_7$...	270.11
20	hydrazine (α)...	.....	$C_{10}H_7 \cdot NH \cdot NH_2$...	158.10
21	" (β)...	.....	$C_{10}H_7 \cdot NH \cdot NH_2$....	158.10
22	ketone (α, β)...	.....	$C_{10}H_7 \cdot CO \cdot C_{10}H_7$...	282.11
23	mercaptan.....	.....	$C_{10}H_7SH$.....	160.13
24	phenylmethane	.....	$C_{10}H_7CH_2C_6H_5$.. ..	218.11
25	Naphthylene diamine	See *diamino-naphthalene*		
26	Narceïne.....	.....	$C_{23}H_{27}O_8N + 3H_2O$	499.27
27	hydrochloride...	.....	$C_{23}H_{27}O_8N \cdot HCl$.... $+ 3H_2O$	535.74
28	Narcotine.....	.....	$C_{22}H_{23}O_7N$.....	413.19
29	Nicotine.....	.....	$C_{10}H_{14}N_2$.....	162.13
30	salicylate.....	.....	$C_{10}H_{14}N_2 \cdot C_7H_6O_3$...	300.18
31	Nicotinic acid....	.....	$C_5H_4N \cdot COOH$.....	123.05
32	Nitracetanilide (o.)	.....	$C_6H_4NO_2C_2H_3ONH$	180.08
33	" (m.)	.....	$C_6H_4NO_2C_2H_3ONH$	180.08
34	" (p.)	.....	$C_6H_4NO_2C_2H_3ONH$	180.08

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form and color	Sp. gr. $H_2O = 1$ (A) Air = 1	Melting-point °C	Boiling-point °C	Solubility in gms. per 100 c.c. of		
					Water	Alcohol	Ether
1	yel.	.....	142.5	>360	.....	v. sl. s.	v. sl. s.
2	liq.	.....	.....	>300	.....	.....	.....
3	need.	.....	82	>300	sl. s.	s.	s.
4	cryst. f. eth.	.....	50	251	v. sl. s.	v. s.	v. s.
5	sm. leaf. f. h. w.	.....	93.5	349.5–50	s. h.	v. s.	v. s.
6	yel. need.	.....	125	.....	sl. s.	s.	v. s.
7	red need. f. eth.	.....	d. 115–20	.....	s.	s.	.....
8	wh. cryst.	.....	95	.....	.....	.....	.....
9	pr.	.....	154	360	sl. s.	sl. s.	s. bz.
10	need. f. al.	.....	44.8	.....	s. h.	s.	v. s.
11	need.	.....	68.5	.....	i.	v. s.	v. s.
12	colorl. need.	1.123$^{25°}$	50	300	0.17	v. s.	v. s.
13	need.	.....	.....	.....	3.77$^{20°}$	v. s.	s.
14	leaf. f. w.	.....	111–2	306	s.	s.	.....
15	leaf.	.....	.....	.....	v. s.	v. s.	s.
16	need. f. w.	.....	.....	.....	*0.02$^{15°}$	v. sl. s.	v. sl. s.
17							
18	colorl. leaf.	.....	110	>360	i.	s. h.	s.
19	colorl.	.....	105	abt. 360	.....	s. h.	v. s.
20	colorl. leaf.	.....	116	.....	v. sl. s. c.	v. s. h.	v. s. chl.
21	colorl. leaf.	.....	124–5	.....	s. chl.	v. s. h.	s. bz.
22	colorl. need. f. al.	.....	135	.....	.....	1.3$^{14°}$	v. s.
23	liq.	.....	.....	285	i.	.....	.....
24	.....	.....	58.6	330–40	s. bz.; s. CS_2	1:30 h.	s.
25							
26	colorl. prisms f. w.	.....	170	.....	0.078$^{13°}$	0.1	.....
27	yel. cryst.	.....	190–2 anh.	.....	sl. s.	s	.....
28	colorl. need. f. al.	.....	176	.....	i.	1$^{20°}$	0.8
29	liq.	1.010$^{20°}$	.....	247.3	∞	∞	∞
30	plates	.....	117.5	.....	s.	s.	.....
31	colorl. need.	.....	228–9	subl.	sl. s. c.; s. h.	s. h.	v. sl. s.
32	yel. leaf.	.....	78	.....	s. d.	.....	v. s.
33	yel. leaf.	.....	141–3	.....	s. h.	.....	i.
34	pr.	.....	207	.....	.....	.....	s.

* All other naphthylamine sulphonic acids have similar solubilities.

No.	Name	Synonyms	Formula	Mol. wt.
1	Nitranilic acid...	dinitrodihydroxy-quinone	$C_6(NO_2)_2(OH)_2O_2$...	230.03
2	Nitraniline (o.)...	.....	$NO_2 \cdot C_6H_4 \cdot NH_2$....	138.06
3	" (m.)..	.....	$NO_2 \cdot C_6H_4 \cdot NH_2$....	138.06
4	" (p.)...	.....	$NO_2 \cdot C_6H_4 \cdot NH_2$....	138.06
5	Nitro-alizarine (α)	.....	$(HO)_2 \cdot C_{14}H_5O_2 \cdot NO_2$	285.06
6	" " (β)	alizarine orange..	$(HO)_2 \cdot C_{14}H_5O_2 \cdot NO_2$	285.06
7	" aminobenzoic acid (1, 2, 5) (COOH, NH_2, NO_2)	.....	$C_6H_3 \cdot COOH \cdot NH_2 \cdot NO_2$	182.06
8	Nitro-aminobenzoic acid (1, 2, 3) (COOH, NH_2, NO_2)	.....	$C_6H_3 \cdot COOH \cdot NH_2 \cdot NO_2$	182.06
9	Nitro-aminobenzoic acid (1, 3, 6) (COOH, NH_2, NO_2)	.....	$C_6H_3 \cdot COOH \cdot NH_2 \cdot NO_2$	182.06
10	Nitro-aminobenzoic acid (1, 3, 2) (COOH, NH_2, NO_2)	.....	$C_6H_3 \cdot COOH \cdot NH_2 \cdot NO_2$	182.06
11	Nitro-aminobenzoic acid (1, 3, 5) (COOH, NH_2, NO_2)	.....	$C_6H_3 \cdot COOH \cdot NH_2 \cdot NO_2$	182.06
12	Nitro-aminobenzoic acid (1, 3, 4) (COOH, NH_2, NO_2)	.....	$C_6H_3 \cdot COOH \cdot NH_2 \cdot NO_2$	182.06
13	Nitro-aminobenzoic acid (1, 4, 3) (COOH, NH_2, NO_2)	.....	$C_6H_3 \cdot COOH \cdot NH_2 \cdot NO_2$	182.06
14	Nitro-aminophenol (6, 1, 2)	.....	$C_6H_3 \cdot OH \cdot NO_2 \cdot NH_2$	154.06
15	" (3, 1, 2)	.....	$C_6H_3 \cdot OH \cdot NO_2 \cdot NH_2$	154.06
16	" (4, 1, 2)	.....	$C_6H_3 \cdot OH \cdot NO_2 \cdot NH_2$	154.06
17	anisol (o.).....	.....	$NO_2 \cdot C_6H_4 \cdot OCH_3$...	153.06
18	" (p.).....	.....	$NO_2 \cdot C_6H_4 \cdot OCH_3$...	153.06
19	anthracene (9)..	nitrosoanthron...	$C_{14}H_9 \cdot NO_2$.....	223.08
20	anthraquinone (α)	.....	$C_6H_4 \cdot (CO)_2 \cdot C_6H_3 \cdot NO_2$	253.06
21	" (o.)	.....	$C_{14}H_7NO_2O_2$.....	253.06
22	benzaldehyde (o.)	.....	$NO_2 \cdot C_6H_4 \cdot CHO$...	151.05
23	" (m.)	.....	$NO_2 \cdot C_6H_4 \cdot CHO$..	151.05
24	" (p.)	.....	$NO_2 \cdot C_6H_4 \cdot CHO$...	151.05
25	benzamide (o.)..	.....	$NO_2 \cdot C_6H_4 \cdot CO \cdot NH_2$	166.06
26	" (m.)	.....	$NO_2 \cdot C_6H_4 \cdot CO \cdot NH_2$	166.06
27	" (p.)..	.....	$NO_2 \cdot C_6H_4 \cdot CO \cdot NH_2$	166.06
28	benzanilide (m.)	.....	$NO_2 \cdot C_6H_4 \cdot CO \cdot NH \cdot C_6H_5$	242.08
29	benzene.....	.....	$C_6H_5 \cdot NO_2$.....	123.03

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form and color	Sp. gr. $H_2O = 1$ (A) Air = 1	Melting-point °C	Boiling-point °C	Solubility in gms. per 100 c.c. of		
					Water	Alcohol	Ether
1	lng. yel. pl.	.....	100	170 d.	v. s.	v. s.	i.
2	need. f. al.	1.443	71.4	.....	v. sl. s.	s.	s.
3	yel. need. f. al.	$1.398^{18°}$	114 (111.8)	285	sl. s.	s.	s.
4	yel. need. f. al.	1.437	146.	.....	$0.08^{19°}$; $2.2^{100°}$	s.	s.
5	yel. need. f. al.	.....	289 d.	.....	sl. s.	s.	s. alk.
6	or. need. f. bz.	.....	244 d	.....	sl. s.	s.	s. chl.
7	yel. need.	.....	263	.....	s. h.	s.	s.
8	yel. need. f. w.	.....	204	.....	.....	v. s.	v. s.
9	yel. need. or pr.	.....	.....	.....	sl. s. h.	s. h.	.....
10	yel. need. f. w.	.....	156–7	.....	v. s. h.	v. s.	v. s.
11	yel. pr. f. w.	.....	208	.....	.....	.....	s. acet. s.
12	red leaf. f. al.	.....	298	.....	sl. s.	s.	s.
13	red yel. need. f. al.	.....	284	.....	i.	sl. s. h.	.....
14	red need. f. al.	.....	110–1	.....	sl. s. h.	s.	v. s. bz.: chl.
15	yel. need.	.....	76	.....	.....	.....	.....
16	or. pr.	.....	80–90	.....	sl. s.	v. s.	v. s.
17	yel. oil	$1.268^{20°}$	9	265	i.	∞	∞
18	colorl. plates	$1.233^{20°}$	54	258–60 c.	v. sl. s.	s.	v. s.
19	yel. need. f. al.	.....	146	.....	v. s. bz.	v. s. CS_2	.....
20	yel. need.	.....	228–30	subl.	i.	sl. s.	sl. s.
21	pr. need.	.....	220	subl.	.....	sl. s.	sl. s.
22	yel. need. f. w.	.....	44.5	153^{23mm}	v. sl. s.	v. s.	v. s.
23	need.	.....	58	164^{23mm}	v. sl. s.	s.	v. s.
24	colorl. prisms	.....	106	.....	sl. s. h.	v. s.	s.
25	need.	.....	174–6	317	s. h.	s.	s.
26	yel. need. f. w.	.....	140–2	310–5	s. h.	s.	s.
27	need.	.....	197–8 (201.4)	.....	v. sl. s.	s.	s.
28	leaf. fr. w.	.....	153–4	subl.	v. sl. s. c.	s	s.
29	yel. liq.	$1.2033^{\frac{2}{4}°}$	5.4	210	v. sl. s.	v. s. c.	v. s.

No.	Name	Synonyms	Formula	Mol. wt.
	Nitro-			
1	benzoic acid (o.)		$NO_2 \cdot C_6H_4 \cdot COOH$	167.05
2	" " (m.)		$NO_2 \cdot C_6H_4 \cdot COOH$	167.05
3	" " (p.)		$NO_2 \cdot C_6H_4 \cdot COOH$	167.05
4	benzonitrile (o.)		$NO_2 \cdot C_6H_4 \cdot CN$	148.05
5	" (m.)		$NO_2 \cdot C_6H_4 \cdot CN$	148.05
6	" (p.)		$NO_2 \cdot C_6H_4 \cdot CN$	148.05
7	benzophenone (o.)		$NO_2 \cdot C_6H_4 \cdot CO \cdot C_6H_5$	227.08
8	" (m.)		$NO_2 \cdot C_6H_4 \cdot CO \cdot C_6H_5$	227.08
9	" (p.)		$NO_2 \cdot C_6H_4 \cdot CO \cdot C_6H_5$	227.08
10	benzoquinone		$NO_2 \cdot C_6H_3O_2$	153.03
11	benzoylformic acid (o.)		$C_6H_4(NO_2)CO \cdot COOH$	195.05
12	benzyl alcohol (o.)		$NO_2 \cdot C_6H_4 \cdot CH_2OH$	153.06
13	" " (m.)		$NO_2 \cdot C_6H_4 \cdot CH_2OH$	153.06
14	" " (p.)		$NO_2 \cdot C_6H_4 \cdot CH_2OH$	153.06
15	" chloride (o.)		$C_6H_4(NO_2) \cdot CH_2Cl$	171.51
16	" " (m.)		$C_6H_4(NO_2) \cdot CH_2Cl$	171.51
17	" " (p.)		$C_6H_4(NO_2) \cdot CH_2Cl$	171.51
18	" cyanide (o.)		$C_6H_4(NO_2) \cdot CH_2CN$	162.06
19	" " (p.)		$C_6H_4(NO_2) \cdot CH_2CN$	162.06
20	benzylidene chloride (m.)		$C_6H_4(NO_2) \cdot CHCl_2$	205.96
21	benzylidene-chloride (p.)		$C_6H_4(NO_2) \cdot CHCl_2$	205.96
22	bromoform		CBr_3NO_2	297.76
23	camphor (α)		$C_{10}H_{15} \cdot NO_2 \cdot O$	197.13
24	chlorbenzene (o.)		$C_6H_4ClNO_2$	157.50
25	" (m.)		$C_6H_4ClNO_2$	157.50
26	" (p.)		$C_6H_4ClNO_2$	157.50
27	chloroform.	See *chlor-picrin*		
28	chlorophenol OH, Cl, NO_2 (1, 2, 5)		$C_6H_3 \cdot Cl \cdot NO_2 \cdot OH$	173.50
29	chlorophenol OH, Cl, NO_2 (1, 3, 6)		$C_6H_3 \cdot Cl \cdot NO_2 \cdot OH$	173.50
30	chlorophenol OH, Cl, NO_2 (1, 4, 2)		$C_6H_3 \cdot Cl \cdot NO_2 \cdot OH$	173.50
31	chlorophenol OH, Cl, NO_2 (1, 2, 4)		$C_6H_3 \cdot Cl \cdot NO_2 \cdot OH$	173.50

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form and color	Sp. gr. $H_2O = 1$ (A)Air = 1	Melting-point °C	Boiling-point °C	Solubility in gms. per 100 c.c. of		
					Water	Alcohol	Ether
1	need. f. w.	$1.575^{4°}$	148	.....	$0.68^{20°}$	$28^{10°}$	$21\ 6^{11°}$
2	leaf. f. w.	$1.494^{4°}$	140	.....	$0.31^{20°}$	$33^{10°}$	$25.1^{11°}$
3	leaf. f. w.	$1.550^{32°}$	238	.....	$0.04^{20°}$	$0.09^{10°}$	$2.2^{11°}$
4	silky need.	.....	109	.....	s. h.	s.	s.
5	need.	.....	117–8 (115)	.....	sl. s.	s.	s.
6	leaf. f. al.	.....	147	.....	sl. s. c.	sl. s. c.; s. h.	s. chl.
7	colorl.	.....	105	.....	.....	sl. s. abs.	.....
8	colorl. need. f. al.	.....	94–5	.....	.....	s.	.....
9	colorl. leaf. f. al.	.....	138	.....	.....	s.	.....
10	yel.	.....	d. abt. 206	.....	v. s. h.	s.	sl. s.
11	need.	.....	46–7	.....	v. s. h.	.....	.....
12	need.	.....	74	.....	sl. s. c.	s.	s.
13	rhomb.	.....	27	.....	.....	.....	.....
14	need. f. w.	.....	93	179.3	sl. s. c.; s. h.	v. s.	v. s.
15	cryst.	.....	48–9	.....	.....	s.	.....
16	yel. need.	.....	45–7	173–$83^{30mm.}$	.....	s.	.....
17	leaf. or need.	.....	71	.....	.....	s.	.....
18	need. f. w.	.....	82.5–4.0	.....	s. h.	.....	.....
19	pr. f. al.	.....	114–6	.....	i.	s.	s.
20	monocl. leaf. or need.	.....	65	.....	.....	s. h.	s. h.
21	pr. f. al.	.....	46	.....	.....	s.	s.
22	.....	$2.811^{12°}$	10	$127^{118mm.}$	i.	s.	s.
23	monocl. pr. f. bz.	.....	100–1	.....	i.	s.	s. chl. s. bz.
24	need.	$1.368^{22°}$	32.5	243	.....	s.	.....
25	rhomb.	1.534	44.4	235.6	.....	s. h.	s.
26	rhomb. leaf.	$1.380^{22°}$	83	242	.....	s.	.....
27							
28	yel. need.	.....	70	.....	sl. s.	s. chl.	.....
29	yel. pr. f. w.	.....	38.9	.....	.....	.....	.....
30	yel. need. f. al.	.....	86–7	.....	v. sl. s.	s.	s.; s. chl.
31	lng. colorl. need. f. al.	.....	110–1	.....	.....	v. s.	v. s.

No.	Name	Synonyms	Formula	Mol. wt.
1	Nitro-cinnamic acid (o)		$NO_2 \cdot C_6H_4 \cdot CH : CH \cdot COOH$	193.06
2	" " (m.)		$NO_2 \cdot C_6H_4 \cdot CH : CH \cdot COOH$	193.06
3	" " (p.)		$NO_2 \cdot C_6H_4 \cdot CH : CH \cdot COOH$	193.06
4	cumene (o. and p.)		$NO_2 \cdot C_6H_4CH(CH_3)_2$	165.10
5	diethyl aniline (m.)		$NO_2 \cdot C_6H_4 \cdot N(C_2H_5)_2$	194.13
6	" " (p.)		$NO_2 \cdot C_6H_4 \cdot N(C_2H_5)_2$	194.13
7	dimethyl amine		$(CH_3)_2N \cdot NO_2$	90.06
8	" aniline (m.)		$NO_2 \cdot C_6H_4 \cdot N(CH_3)_2$	166.10
9	" " (p.)		$NO_2 \cdot C_6H_4 \cdot N(CH_3)_2$	166.10
10	diphenyl (o.)		$C_6H_5 \cdot C_6H_4 \cdot NO_2$	199.08
11	" (p.)		$C_6H_5 \cdot C_6H_4 \cdot NO_2$	199.08
12	ethane		$C_2H_5 \cdot NO_2$	75.06
13	erythrite		$C_4H_6(ONO_2)_4$	302.08
14	glycerine	glyceryl trinitrate	$C_3H_5(NO_3)_3$	227.06
15	glycerol, Di-β		$C_3H_5(OH)(ONO_2)_2$	182.06
16	" Mono-α		$C_3H_5(OH)_2(ONO_2)$	137.06
17	" Mono-β		$C_2H_5(OH)_2(ONO_2)$	137.06
18	guanidine		$NH_2 \cdot CNH \cdot NHNO_2$	104.06
19	isatine		$C_6H_3(NO_2) \cdot NHCO \cdot CO$	192.05
20	isoquinoline		$C_6H_3(NO_2) : C_3H_3N$	174.06
21	mannite		$C_6H_8(ONO_2)_6$	452.11
22	mesitylene (CH_3, CH_3, CH_3, NO_2) (1, 3, 5, 6)		$C_6H_2NO_2(CH_3)_3$	165.10
23	methane		$CH_3 \cdot NO_2$	61.03
24	naphthalene (α)		$C_{10}H_7 \cdot NO_2$	173.06
25	" (β)		$C_{10}H_7 \cdot NO_2$	173.06
26	naphthoic acid (8, 1)		$C_{10}H_6(NO_2) \cdot COOH$	217.06
27	naphthol (2, 1)		$NO_2 \cdot C_{10}H_6 \cdot OH$	189.06
28	" (4, 1)		$NO_2 \cdot C_{10}H_6 \cdot OH$	189.06
29	" (1, 2)		$NO_2 \cdot C_{10}H_6 \cdot OH$	189.06
30	" (5, 2)		$NO_2 \cdot C_{10}H_6 \cdot OH$	189.06
31	" (8, 2)		$NO_2 \cdot C_{10}H_6 \cdot OH$	189.06
32	naphthylamine (2, 1)		$NO_2 \cdot C_{10}H_6 \cdot NH_2$	188.08
33	" (1, 2)		$NO_2 \cdot C_{10}H_6 \cdot NH_2$	188.08
34	" (5, 2)		$NO_2 \cdot C_{10}H_6 \cdot NH_2$	188.08
35	" (8, 2)		$NO_2 \cdot C_{10}H_6 \cdot NH_2$	188.08

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form and color	Sp. gr. $H_2O = 1$ (A)Air = 1	Melting-point °C	Boiling-point °C	Solubility in gms. per 100 c.c. of		
					Water	Alcohol	Ether
1	sc. or need. f. al.	.....	240	.....	i. c.	sl. s. c.	.....
2	yel. need.	.....	196–7	.....	v. sl. s.	.....	.....
3	pr. f. al.	.....	284–6	.....	v. sl. s.	sl. s. h.	v. sl. s.
4	.....	$1.1025^{20°}_{0}$	–35	d. 224	.....	.....	.....
5	yel. oil	.....	.....	288–90	.....	.....	.....
6	need.	.....	77–8	.....	.....	v. s. h.	sl. s. lgr.
7	.....	.....	57–8	187	s	s.	s.
8	red pr. f. eth.	$1.313^{17°}$	60–1	280–5 d.	i.	s.	s.
9	need. f. al.	.....	163–4	.....	i.	s.	s. conc. HCl
10	leaf. f. al.	.....	37	320	i.	v. s.	v. s.
11	need. f. al.	.....	114	340	i.	sl. s. c.	s.
12	liq.	1.056	.....	114–5	sl. s.	∞	∞
13	leaf. f. al.	.....	61	expl.	s. h.	.....	.....
14	colorl.-yel. liq.	1.601	13	expl. 260	0.12	25	∞
15	liq.	.....	.....	$145^{15mm.}$	.....	.....	.....
16	.....	1.40	58	155–6 15mm.	70	.....	.....
17	.....	.....	54	155–60 15mm.	.....	.....	.....
18	need.	.....	230 (240)	.....	v. sl. s. c.; sl. s. h.	sl. s.	i.
19	rosettes f. al.	.....	226–30	.....	sl. s.	v. s.	s. KOH
20	need.	.....	110	.....	s. h.	s.	.....
21	need.	$1.604^{0°}$	108	120 exp.	i.	s. h	s.
22	tricl. pr. f. al.	.....	41–2	255	.....	.....	.....
23	liq.	1.144	–26	101	sl. s.	s. alk.	s.
24	yel. need.	.....	61	304	i.	s.	$2.8^{15°}$
25	rhomb. need.	.....	79	.....	i.	v. s.	v. s.
26	prisms f. al.	.....	215	.....	0.04 c.	4.6	sl. s.
27	leaf.	.....	128	.....	v. sl. s.	sl. s.	.....
28	yel. need. f. w.	.....	164	.....	s. h.	v. s.	.....
29	yel.	.....	103	.....	.....	v. sl. s. c.	v. s.
30	yel. need.	.....	147	.....	.....	v. s.	.....
31	yel. need. f. w.	.....	144–5	.....	s.	v. s.	.....
32	yel. pr. f. al.	.....	144	.....	.....	s.	.....
33	or. yel. need.	.....	abt. 125	.....	s. h.	v. s.	.....
34	red. need. f. al.	.....	143.5	.....	.....	v. s. h.	s. bz.
35	red. need.	.....	103.5	.....	.....	v. s.	.....

No.	Name	Synonyms	Formula	Mol. wt.
1	Nitro-phenol (o.)		$NO_2 \cdot C_6H_4 \cdot OH$	139.05
2	" (m.)		$NO_2 \cdot C_6H_4 \cdot OH$	139.05
3	" (p.)		$NO_2 \cdot C_6H_4 \cdot OH$	139.05
4	phenylpropiolic acid (o.)		$C_6H_4NO_2C \vdots C \cdot COOH$	191.05
5	phenylpropiolic acid (p.)		$C_6H_4NO_2C \vdots C \cdot COOH$	191.05
6	phthalic acid (3)		$NO_2 \cdot C_6H_3 \cdot (COOH)_2$	211.05
7	" " (4)		$NO_2 \cdot C_6H_3 \cdot (COOH)_2 + H_2O$	229.06
8	" (1, 3, 5)		$NO_2 \cdot C_6H_3 \cdot (COOH)_2 + 1\frac{1}{2}H_2O$	238.07
9	phthalide (5)		$NO_2 \cdot C_8H_5O$	163.05
10	propane		$CH_3 \cdot CH_2 \cdot CH_2 \cdot NO_2$	89.06
11	pseudocumene (1, 3, 4, 6)		$C_6H_2NO_2(CH_3)_3$	165.10
12	pseudocumene (1, 3, 4, 5)		$C_6H_2NO_2(CH_3)_3$	165.10
13	quinoline (5)		$NO_2 \cdot C_9H_6N$	174.06
14	" (6)		$NO_2 \cdot C_9H_6N$	174.06
15	" (7)		$NO_2 \cdot C_9H_6N$	174.06
16	" (8)		$NO_2 \cdot C_9H_6N$	174.06
17	salicylic acid (3)		$NO_2 \cdot C_6H_3(OH) \cdot COOH + H_2O$ (3, 2, 1)	201.06
18	" " (5)		$NO_2 \cdot C_6H_3(OH) \cdot COOH$ (5, 2, 1)	183.05
19	" " (1, 2, 6)		$NO_2 \cdot C_6H_3(OH) COOH$	183.05
20	styrene (o.)		$NO_2 \cdot C_6H_4 \cdot CH : CH_2$	149.06
21	" (m.)		$NO_2 \cdot C_6H_4 \cdot CH : CH_2$	149.06
22	" (p.)		$NO_2 \cdot C_6H_4 \cdot CH : CH_2$	149.06
23	tartaric acid		$(NO_3)_2C_2H_2(COOH)_2$	240.05
24	terephthalic acid		$C_6H_3NO_2(COOH)_2$	211.05
25	thiophene (2)		$NO_2 \cdot C_4H_3S$	129.10
26	toluene (o.)		$NO_2 \cdot C_6H_4 \cdot CH_3$	137.06
27	" (m.)		$NO_2 \cdot C_6H_4 \cdot CH_3$	137.06
28	" (p.)		$NO_2 \cdot C_6H_4 \cdot CH_3$	137.06
29	o-toluidine (3)		$NO_2 \cdot C_6H_3 \cdot CH_3 (NH_2)$ (3, 1, 2)	152.08
30	" " (4)		$NO_2 \cdot C_6H_3 \cdot CH_3 (NH_2)$ (4, 1, 2)	152.08
31	" " (5)		$NO_2 \cdot C_6H_3 \cdot CH_3 (NH_2)$ (5, 1, 2)	152.08
32	" " (6)		$NO_2 \cdot C_6H_3 \cdot CH_3 (NH_2)$ (6, 1, 2)	152.08
33	m- " (2)		$NO_2 \cdot C_6H_3 \cdot CH_3 (NH_2)$ (2, 1, 3)	152.08
34	" " (4)		$NO_2 \cdot C_6H_3 \cdot CH_3 (NH_2)$ (4, 1, 3)	152.08

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form and color	Sp. gr. $H_2O = 1$ (A)Air = 1	Melting-point °C	Boiling-point °C	Solubility in gms. per 100 c.c. of		
					Water	Alcohol	Ether
1	prisms	.....	45.2	214	v. sl. s. c.	v. s.	v. s.
2	tab.	.....	96	.....	sl. s. c.; s. h.	v. s.	v. s.
3	monocl.	.....	114	279 d.	sl. s. c.; s. h.	v. s.	v. s.
4	need. f. h. w.	.....	155.5 d.	.....	v. s. h.	s.	s.; sl. s. chl.
5	need. f. al.	. .. .	181 d.	.....	sl. s.	s. h.	s.
6	yel. monocl. f. eth.	.....	219–20	.... .	sl. s.	v. s.	v. s.
7	need.	.....	161	.....	s.	s.	s.
8	gr. leaf.	.....	248–9	.....	sl. s.	v. s.	.....
9	need. f. al.	.....	141	.....	i. c.	s.	s.
10	liq.	1.011	.....	131	v. sl. s.	∞	∞
11	lng. yel. need.	.....	71	265	.....	s.	.....
12	grn. pr.	.....	20	.....	.....	s.	.....
13	need. f. w.	.....	72	subl.	sl. s. h.	s. bz.	.....
14	need.	.....	149–50	subl.	v. sl. s. c. s. h.	v. sl. s.	v. sl. s.
15	need. f. al.	.....	132–3	.....	.....	v. sl. s.	v. s.
16	need. f. al.	.....	88–9	.....	v. sl. s. c.	s.	s.
17	long need.	.....	144 anh.	.....	0.13 c.	v. s.	v. s.
18	need.	.....	228–30	.....	0.07 c.; s. h.	v. s.	v. s.
19	yel. need.	.....	195	.....	.....	sl. s.	v. sl. s.
20	colorl. liq.	.....	12–13.5	.....	s. conc. H_2SO_4	.....	.....
21	.....	.....	–5	.....	.....	s. abs.	s.; s. lgr.
22	pr. f. lgr.	.....	29	.....	s. lgr.	v. s. h.	v. s.
23	cryst.	.....	d.	.....	.....	s.	s.
24	.....	.....	270	.....	v. s. h.	s. h.	.....
25	monocl.	.....	44	224–5	i.	v. s.	v. s.
26	yel. liq.	1.168	–10.5	220.4	v. sl. s. c.	∞	∞
27	.....	$1.168^{22°}$	15.9	232	v. sl. s. c.	∞	∞
28	colorl. need.	$1.286^{20°}$	52	237.7	v. sl. s.	s.	v. s.
29	or. prisms	.....	96	.....	v. s. bz.	v. s.	v. s.
30	monocl.	1.365	179	.....	.....	s.	s.
31	yel. need.	1.366	127–8	.....	v. sl. s. h.	v. s.	.....
32	yel. leaf.	1.378	91.5	.....	1.3 h.	v. s.	v. s.
33	yel. need.	.....	53	.....	sl. s.	v. s.	.....
34	yel. leaf. f. w.	.....	109	.....	s. h.	v. s.	v. s.

No.	Name	Synonyms	Formula	Mol. wt.
1	Nitro-m-toluidine (5)		$NO_2 \cdot C_6H_3 \cdot CH_3(NH_2)$ (5, 1, 3)	152.08
2	" " (6)		$NO_2 \cdot C_6H_3 \cdot CH_3(NH_2)$ (6, 1, 3)	152.08
3	p- " (2)		$NO_2 \cdot C_6H_3 \cdot CH_3(NH_2)$ (2, 1, 4)	152.08
4	" " (3)		$NO_2 \cdot C_6H_3 \cdot CH_3(NH_2)$ (3, 1, 4)	152.08
5	urethane		$NO_2 \cdot NH \cdot COO \cdot C_2H_5$	134.06
6	urea		$NH_2 \cdot CO \cdot NHNO_2$	105.05
7	xylene $CH_3CH_3NO_2$ 1, 2, 3		$C_6H_3(NO_2)(CH_3)_2$	151.08
8	xylene $CH_3CH_3NO_2$ 1, 2, 4		$C_6H_3(NO)_2(CH_3)_2$	151.08
9	xylene $CH_3CH_3NO_2$ 1, 3, 2		$C_6H_3(NO_2)(CH_3)_2$	151.08
10	xylene $CH_3CH_3NO_2$ 1, 3, 5		$C_6H_3(NO_2)(CH_3)_2$	151.08
11	xylene $CH_3CH_3NO_2$ 1, 4, 2		$C_6H_3(NO_2)(CH_3)_2$	151.08
12	Nitroform	trinitro-methane	$CH(NO_2)_3$	151.03
13	Nitroso-aniline (p.)		$NO \cdot C_6H_4 \cdot NH_2$	122.06
14	benzene		C_6H_5NO	107.05
15	benzoic acid (o.)		$NO \cdot C_6H_4 \cdot COOH$	151.05
16	diethylamine		$(C_2H_5)_2N \cdot NO$	102.10
17	diethylaniline (p.)		$NO \cdot C_6H_4 \cdot N(C_2H_5)_2$	178.13
18	diisopropylamine		$[(CH_3)_2 \cdot CH]_2N \cdot NO$	130.13
19	dimethylamine		$(CH_3)_2N \cdot NO$	74.06
20	dimethylaniline (p.)		$NO \cdot C_6H_4 \cdot N(CH_3)_2$	150.10
21	diphenylamine		$(C_6H_5)_2 \cdot N \cdot NO$	198.10
22	dipropylamine		$(CH_3 \cdot CH_2 \cdot CH_2)_2N \cdot NO$	130.13
23	indoxyl		$C_6H_4N(NO)CH{:}\,C(OH)$	162.06
24	naphthol (2, 1)		$NO \cdot C_{10}H_6 \cdot OH$	173.06
25	" (4, 1)		$NO \cdot C_{10}H_6 \cdot OH$	173.06
26	" (1, 2)		$NO \cdot C_{10}H_6 \cdot OH$	173.06
27	naphthylamine (1, 2)		$NO \cdot C_{10}H_6NH_2$	172.08

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form and color	Sp. gr. $H_2O = 1$ (A) Air = 1	Melting-point °C	Boiling-point °C	Solubility in gms. per 100 c.c. of		
					Water	Alcohol	Ether
1	or. need.	.....	98	.....	v. sl. s.	v. s.	v. s.
2	yel. need.	.....	138	.....	s. a.	s.	.....
3	yel. monocl.	.....	77.5	.....	s.	sl. s. CS_2	.....
4	red. pr. f. al.	1.312	114 (116–7)	.....	v. sl. s. h.	v. s.	.....
5	colorl. leaf. fr. lgr.	.....	64	.....	v. s.	s. lgr.	.....
6	cryst. powd.	.....	dec.	.....	sl. s.	v. s.	v. s.
7	liq.	$1.147^{15°}$	.....	$250^{71mm.}$	.....	.....	.....
8	pr.	$1.139^{30°}$	29	258	.....	as abv. 30°	.....
9	liq.	$1.112^{15°}$	.....	225	.....	.....	.....
10	grn. need.	.....	74–5	273	.....	.....	s.
11	liq.	$1.132^{15°}$	.....	234–7	.....	.....	.....
12	colorl. oil	.....	15	exp.	s.	.....	.....
13	steel blue need.	.....	173–4	.....	s. bz.	s.	.....
14	colorl. monocl. f. eth.	.....	67.5–8.0	.....	.....	s.	s.
15	colorl. f. abs. al.	.....	210 d.	.....	v. sl. s. bz.	s.	v. sl. s.
16	yel. liq.	$0.951^{18°}$	.....	175.4	s.	∞	∞
17	need.	.....	84	.....	sl. s.	v. s.	v.s.
18	.....	.....	46	194.5	v. sl. s.	v. s.	.....
19	yel.	.....	.....	148	v. s.	∞	∞ M
20	green scales	.....	87.8	.....	v. sl. s.	s.	s.
21	yel. tab.	.....	66.5	.....	.....	v. sl. s. c.; s. h.	s. bz.
22	yel. liq.	0.924	.....	296 (200–5)	v. sl. s.	∞	∞
23	yel. need.	.....	202	.....	sl. s.	s.	.....
24	yel. need. f. bz.	.....	147–8 (152)	.....	v. sl. s. c.	v. s.	s.
25	yel.	.....	abt. 193 d.	.....	i.	v. s.	v. s.
26	brown pr. f. al.	.....	109.5 (106)	.....	v. sl. s.	$2.4^{12°}$; v. s. h.	v. s.
27	gr'n. need. f. al.	.....	150–2	.....	sl. s. h.	v. s.	v. s.

No.	Name	Synonyms	Formula	Mol. wt.
1	Nitrophenol (p.)	quinone monoxime	$NO \cdot C_6H_4 \cdot OH$	123.05
2	toluene (o.)	.....	$NO \cdot C_6H_4 \cdot CH_3$	121.06
3	Nonane (n.)	.....	C_9H_{20}	128.16
4	" (α)	.....	C_9H_{20}	128.16
5	" (β)	.....	C_9H_{20}	128.16
6	Nondecylic acid	.....	$C_{18}H_{37} \cdot COOH$	298.30
7	Nonyl alcohol	.....	$C_9H_{19}OH$	144.16
8	Nonylene	.....	C_9H_{18}	126.14
9	Nonylic acid	pelargonic acid	$C_8H_{17} \cdot COOH$	158.14
10	Octane (n.)	.....	C_8H_{18}	114.14
11	Octyl alcohol (n.)	.....	$C_8H_{17}OH$	130.14
12	aldehyde	.....	$CH_3 \cdot (CH_2)_6 \cdot CHO$	128.13
13	amine	.....	$CH_3 \cdot (CH_2)_7 \cdot NH_2$	129.16
14	" (sec.)	.....	$CH_3(CH_2)_5CH(NH_2)CH_3$	129.16
15	chloride (n.)	.....	$CH_3(CH_2)_6CH_2 \cdot Cl$	148.59
16	" (sec.)	.....	$CH_3(CH_2)_5CHCl \cdot CH_3$	148.59
17	formate	.....	$H \cdot COO \cdot C_8H_{17}$	158.14
18	Octylene (n.)	.....	$CH_3(CH_2)_5CH{:}\,CH_2$	112.13
19	Oenanthol	heptylic aldehyde	$C_6H_{13} \cdot CHO$	114.11
20	Oenanthylic acid	heptylic acid	$C_6H_{13} \cdot COOH$	130.11
21	Oleic acid	.....	$C_{17}H_{33} \cdot COOH$	282.27
22	Olein	triolein	$(C_{18}H_{33}O_2)_3C_3H_5$	884.83
23	Opianic acid	.....	$(CH_3O)_2C_6H_2(CHO) \cdot COOH$	210.08
24	Orcein	.....	$C_{28}H_{24}N_2O_7$	500.21
25	Orcin-phthalein	.....	$C_{22}H_{16}O_5$	360.13
26	Orsellinic acid COOH, OH, CH_3, OH 1, 2, 4, 6	.....	$C_6H_2(OH)_2CH_3COOH$	168.06
27	Oxalic acid	.....	$(COOH)_2 + 2H_2O$	126.05
28	Oxaluramide	oxalan	$C_3H_5N_3O_3$	131.06
29	Oxaluric acid	.....	$NH_2CO \cdot NH \cdot CO \cdot COOH$	132.05
30	Oxalyl chloride	.....	$COCl \cdot COCl$	126.93
31	Oxamaethane	.....	$NH_2 \cdot CO \cdot COO \cdot C_2H_5$	117.06
32	Oxamic acid	.....	$COOH \cdot CONH_2$	89.03
33	Oxamide	.....	$CONH_2 \cdot CONH_2$	88.05
34	Oxanilic acid	.....	$COOH \cdot CONHC_6H_5$	165.06
35	Oxanilide	.....	$C_6H_5 \cdot NH \cdot CO \cdot CO \cdot NH \cdot C_6H_5$	240.11
36	Oxanthranol	anthrahydroquinone	$C_6H_4COCHOHC_6H_4$	210.08
37	Oximide	.....	$NH \cdot CO \cdot CO$	71.02
38	Oxindol	.....	C_8H_7ON	133.06
39	Palmitic acid	.....	$CH_3 \cdot (CH_2)_{14} \cdot COOH$	256.26
40	Palmitin	tripalmitin	$(C_{15}H_{31} \cdot COO)_3C_3H_5$	806.78

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form and color	Sp. gr. $H_2O = 1$ (A) Air = 1	Melting-point °C	Boiling-point °C	Solubility in gms. per 100 c.c. of		
					Water	Alcohol	Ether
1	yel. needs.	....	120–30 d.	.....	s.	v. s.	v. s.
2	cryst.	.....	72–2.5	.....	v. s. chl.	v. s.	v. s.
3	colorl. liq.	$0.718^{20°}$	−51	149.7	i.	v. s.	v. s.
4	.....	$0.742^{12.4°}$	.....	135–7	.....	.....	.....
5	.....	$0.734^{12.7°}$	.....	129.5–31 $^{751mm.}$	.....	.....	.....
6	leaf. f. al.	.....	66.5	.....	i.	.....	.....
7	liq.	$0.842^{0°}$	−5	213.5	.....	∞	∞
8	.....	$0.7433^{20°}_{4}$	.....	140	.....	.....	.....
9	liq.	$0.689^{17.5}_{4}$	12.5	253–4	v. sl. s.	s.	s.
10	colorl. liq.	0.706	−56.6	125.5	i.	.....	.....
11	colorl. liq.	$0.838^{0°}$	−17.9	195.5	s.	∞	∞
12	colorl. liq.	$0.821^{20°}$	.....	.....	v. sl. s.	∞	∞
13	.....	.....	.....	176	v. sl. s.	v. s.	v. s.
14	.....	0.786	.....	162.5	.....	.....	.....
15	.....	0.8924^{0}_{0}	.....	183.6–4.6	.....	.....	.....
16	.....	$0.8707^{15°}$	.....	171–3	.....	.....	.....
17	colorl. liq.	$0.893^{0°}$	.....	198	i.	.....	.....
18	.....	$0.7223^{20°}_{4}$	.....	124.6 $^{769mm.}$	.....	.....	.....
19	colorl. liq.	$0.850^{20°}$	.....	155	.....	s.	∞
20	colorl. liq.	0.921	.....	223	sl. s.	s.	s.
21	need.	$0.891^{12°}$	14	$286^{100mm.}$	i.	∞	∞
22	oil	.....	−5–6	.....	i.	sl. s.	v. s.
23	pr.	.....	150	.....	0.25; $1.7^{100°}$	s.	s.
24	red.	.....	.....	.....	.....	s.	s. alk.
25	colorl. pr.	.....	230 d.	.....	i.	s.	i.; s. alk
26	need. f. acet.	.....	176 d.	.....	s.	s.	s.
27	colorl. monocl.	1.653	99*	.....	$9.5^{15°}$	v. s. c.	$1.2^{15°}$
28	cryst.	.....	.....	.....	i.	s.	s. H_2SO_4
29	cryst. powd.	.....	187	.....	v. sl. s.	.....	.....
30	colorl. liq.	.....	−12	64	d.	d.	s.
31	rhomb. leaf.	$0.808^{19°}$	114–5	.....	.....	.....	.....
32	colorl.	.....	210 d.	.....	$1.4^{14°}$	v. sl. s.	.....
33	wh. powd.	$1.476^{20°}$	417–9 d.	.....	i.	i.	i.
34	rhombic	.....	149	.....	s. h.	v. s.	v. s.
35	scales	.....	245 (252.5)	.....	i.	v. sl. s. h.	i.
36	yel.	.....	.....	.....	s. alk.	.....	.....
37	pr.	.....	.....	.....	sl. s.	.....	.....
38	need. f. w.	.....	120	.....	v. s. h.	s.	s.
39	colorl. need.	$0.853^{62°}$	62.6	dec.	i.	$9.3^{20°}$	s.
40	colorl.	$0.866^{80°}$...	65.5	.....	i.	v. sl. s.	v. s.

* Anhydrous form melts at 187° C.

No.	Name	Synonyms	Formula	Mol. wt.
1	Palmitone		$(C_{15}H_{31})_2CO$	450.50
2	Palmitolic acid		$C_{15}H_{27}\cdot COOH$	252.22
3	Palmito-nitrile		$C_{15}H_{31}\cdot CN$	237.26
4	Papaverine		$C_{20}H_{21}O_4N$	339.18
5	Parabanic acid	oxalyl urea	$C_3H_2O_3N_2$	114.03
6	Paraconic acid	itamalic anhydride	$CH_2COOCH_2{:}\ CH\cdot$ COOH	130.05
7	Paraconiin		$C_8H_{15}N$	125.13
8	Paracyanogen		$(CN)x$	(26.01)x
9	Paraformaldehyde		$(CH_2O)x$	(30.02)x
10	Paralactic acid (d.)		$CH_3\cdot CHOH\cdot COOH$	90.05
11	Paraldehyde		$(C_2H_4O)_3$	132.10
12	Paraldol		$(C_4H_8O_2)_2$	176.13
13	Paraleukaniline	triaminotriphenyl-methane	$CH(C_6H_4NH_2)_3$	289.18
14	Param	dicyandiamide	$C_2N_2(NH_2)_2$	84.06
15	Pararosaniline	triamino triphenyl-carbinol	$C(OH)(C_6H_4NH_2)_3$	305.18
16	Parvoline (α)		$C_9H_{13}N$	135.11
17	" (β)		$C_5H(CH_3)_4N$	135.11
18	Pelargonic acid		$CH_3\cdot(CH_2)_7COOH$	158.14
19	Penta-aminoben-zene		$C_6H(NH_2)_5$	153.03
20	acetylglucose		$C_6H_7O(OC_2H_3O)_5$	390.18
21	bromobenzene		C_6HBr_5	472.59
22	chloraniline		$Cl_5C_6\cdot NH_2$	265.40
23	chlorbenzene		C_6HCl_5	250.29
24	chlorethane		$CCl_3\cdot CHCl_2$	202.29
25	decane (n.)		$CH_3\cdot(CH_2)_{13}\cdot CH_3$	212.26
26	erythrite		$C(CH_2OH)_4$	136.10
27	ethylbenzene		$C_6H\cdot(C_2H_5)_5$	218.21
28	glycerol		$CH_3\cdot C(CH_2OH)_3$	120.10
29	methyl aminoben-zene		$C_6(CH_3)_5NH_2$	163.14
30	" benzene		$C_6H\cdot(CH_3)_5$	148.13
31	" benzoic acid		$(CH_3)_5\cdot C_6\cdot COOH$	192.13
32	" ethanol		$(CH_3)_3C\cdot C(OH)(CH_3)_2$	116.13
33	" phenol		$(CH_3)_5\cdot C_6\cdot OH$	164.13
34	" rosaniline	methylaniline violet	$C_{24}H_{29}N_3O$	375.26
35	methylene	cyclo pentane	C_5H_{10}	70.08
36	" bromide		$CH_2Br(CH_2)_3CH_2Br$	229.91
37	" diamine	cadaverine	$NH_2\cdot(CH_2)_5\cdot NH_2$	102.13
38	aminobenzene		$C_6H\cdot(NH_2)_5$	153.13
39	Pentane (n.)		C_5H_{12}	72.10
40	" (sec.)		$(CH_3)_2CH\cdot CH_2\cdot CH_3$	72.10
41	" (tert.)		$C(CH_3)_4$	72.10

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form and color	Sp. gr. $H_2O = 1$ (A) Air = 1	Melting-point °C	Boiling-point °C	Solubility in gms. per 100 c.c. of		
					Water	Alcohol	Ether
1	leaf. f. al.	$0.7997^{4°}$	82.8	.....	.....	.....	.....
2	colorl. need.	.....	47	.....	i.	v. s.	v. s.
3	colorl. tab.	$0.822^{31°}$	29(31)	251.5 100mm	i.	s.	s.
4	colorl. need. f. al.	.....	146–7	.....	v.sl.s.s.h.	v. s.; v. s. chl.	$0.39^{10°}$
5	colorl. pl. f. w.	.....	227–35 d.	.....	$4.7^{8°}$	v. s.	sl. s.
6	deliq. cryst.	.....	57–8	.....	s.	.....	.....
7	liq.	$0.913^{0°}$	.....	168–70	.....	.....	.....
8	br. powd.	.....	.....	subl.	i.	i.	s. KOH
9	wh. amor. powd.	.....	subl. abt. 120	.....	v. s.	i.	i.
10	liq.	.....	.....	d.	∞	∞	∞
11	colorl.	0.999	10.5	124	10	.....	.....
12	wh. cryst.	.....	80–90	.....	.....	.....	.....
13	colorl. leaf.	.....	148	.....	.....	s.	.....
14	leaf.	.....	205	.....	s.	s.	sl. s.
15	red. leaf.	.....	188–9	.....	i.	s.	s.
16	liq.	$0.986^{22°}$	.....	188	.....	.....	.....
17	liq.	.....	.....	220	.....	.....	.....
18	colorl. leaf.	0.910	12.5	253–4	v. sl. s.	s.	s.
19	need.	.....	.....	.....	v. s.	i.	i.
20	.....	.....	111	.....	.....	.....	.....
21	need. f. al.	.....	159–60	subl.	s. bz.	sl. s.	sl. s.
22	need.	.....	232	.....	.....	v. s.	v. s.
23	need. f. al.	$0.769^{20°}$	85–6	275–6	i.	v. sl. s.	v. s.
24	liq.	1.834	−22	161.7	i.	∞	∞
25	colorl.	$0.769^{20°}$	10	270.5	i.	v. s.	v. s.
26	.....	.....	250–5	.....	.....	.....	.....
27	colorl. liq.	$0.899^{19°}$	<−20	277	i.	.....	.....
28	.....	.....	.....	199	s.	.....	.....
29	need. f. al.	.....	151–2	277–8	i.	s.	s.
30	colorl.	.....	53	230	i.	.....	.....
31	need. f. w.	.....	210.5	subl.	v. sl. s.	s.	.....
32	.....	.....	17	131–2	.....	.....	.....
33	need. f. al.	.....	125	267	i.	s.	.....
34	red. br. powd.	.....	130	.....	i.	s.	i.
35	colorl. liq.	$0.751^{20°}$	.....	50–1	i.	.....	.....
36	.....	.....	.....	205	.....	.....	.....
37	symp.	0.885	abt. 9.	178–9	v. s.	sl. s.	sl. s.
38	need.	.....	.....	.....	v. s.	i.	i.
39	colorl. liq.	0.634	.....	37	i.	∞	∞
40	liq.	$0.6385^{14°}$	.....	30	.....	.....	.....
41	.....	.....	solid. −20	9.5	.....	.....	.....

No.	Name	Synonyms	Formula	Mol. wt.
	Perchlorethane.	See *hexachlorethane*		
1	Perchlorether....	.....	$C_2Cl_5 \cdot O \cdot C_2Cl_5$.....	418.57
2	Perchlormethyl-mercaptan	.....	CCl_3SCl.....	185.89
3	Perseite (d. or l.).	.....	$C_7H_{16}O_7$.....	212.13
4	Phellandrene.....	.....	$C_{10}H_{16}$.....	136.13
	Penacetin.	See *acetphenetidide*		
5	Phenacylbromide.	bromacetophenone	$C_6H_5CO \cdot CH_2Br$....	198.97
6	Phenanthrene....	.....	$C_{14}H_{10}$.....	178.08
7	Phenanthrenehydroquinone	.....	$C_{14}H_8(OH)_2$.....	210.08
8	Phenanthrenequinone	.....	$C_{14}H_8O_2$.....	208.06
9	Phenanthranol...	.....	$C_{14}H_9 \cdot OH$.....	194.08
10	Phenazine.....	.....	$C_{12}H_8N_2$.....	180.08
11	Phenetidine (o.)..	aminophenylethyl-ether	$C_2H_5 \cdot O \cdot C_6H_4 \cdot NH_2$.	137.10
12	" (m.).	.....	$C_2H_5 \cdot O \cdot C_6H_4 \cdot NH_2$.	137.10
13	" (p.)..	.....	$C_2H_5 \cdot O \cdot C_6H_4 \cdot NH_2$.	137.10
14	Phenetol.....	phenylethyl ether	$C_6H_5 \cdot O \cdot C_2H_5$.....	122.08
15	Phenocoll.....	aminoacetyl-phenetidine	$C_2H_5O \cdot C_6H_4 \cdot NH \cdot CO \cdot CH_2NH + H_2O$	211.14
16	Phenol.....	carbolic acid.....	$C_6H_5 \cdot OH$.....	94.08
17	phthalein.....	.....	$C_{20}H_{14}O_4$.....	318.12
18	sulfonic acid (o.)	.....	$C_6H_4 \cdot OH \cdot SO_3H$....	174.12
19	" " (m.)	.....	$C_6H_4 \cdot OH \cdot SO_3H + 2H_2O$	210.14
20	" " (p.)	.....	$C_6H_4 \cdot OH \cdot SO_3H$....	174.12
21	tricarboxylic acid	.....	$C_6H_2(OH)(COOH)_3$.	226.06
22	Phenthiazine.....	.....	$C_6H_4 \cdot NH \cdot C_6H_4 \cdot S$	199.14
23	Phenyl-acetanilide	.....	$C_6H_5 \cdot NH \cdot OC \cdot CH_2 \cdot C_6H_5$	211.12
24	acetaldehyde...	.....	$C_6H_5 \cdot CH_2 \cdot CHO$...	120.06
25	acetate.....	.....	$CH_3 \cdot COO \cdot C_6H_5$..	136.06
26	acetic acid.....	.....	$C_6H_5 \cdot CH_2 \cdot COOH$..	136.06
27	acetylene.....	.....	$C_6H_5 \cdot C \vdots CH$	102.06
28	acridine (9).....	.....	$C_6H_5 \cdot C_{13}H_8N$.....	255.12
29	amino-propionic acid (β, α)	phenyl alanine...	$C_6H_5 \cdot CH_2 \cdot CH(NH_2)COOH$	165.10
30	amino-propionic acid (β, β)	.....	$C_6H_5 \cdot CH(NH_2) \cdot CH_2 \cdot COOH$	165.10
31	amyl ether.....	.....	$C_6H_5 \cdot OC_5H_{11}$.....	164.10
32	angelic acid....	.....	$C_6H_5 \cdot CH: C(C_2H_5)COOH$	176.10
33	anthracene.....	.....	$C_{14}H_9(C_6H_5)$.....	254.12

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form and color	Sp. gr. H_2O = 1 (A) Air = 1	Melting-point °C	Boiling-point °C	Solubility in gms. per 100 c.c. of		
					Water	Alcohol	Ether
1	scales	1.900	69	d.	.....	.....	.....
2	yel. liq.	1.712	.....	147	i.	.....	.....
3	colorl. need.	.....	188	.....	$5.5^{18°}$	sl. s.	.....
4	.....	$0.8558^{10°}$	.....	172^{766mm}	.....	i.	s.
5	trim. pr. f. al.	.....	50	.....	.....	v. s.	v.s.
6	colorl. leaf.	$1.063^{100°}$	100	340	i.	10 h.	v. s.
7	.....	.....	.....	.....	s. h.	.....	.....
8	or. need.	.....	202	360	sl. s. h.	sl. s.	sl. s.
9	need.	.....	112 (152)	.....	sl. s.	v. s.	v. s.
10	yel. need.	.....	170–1	abt. 360	v. sl. s.	2	sl. s.
11	liq.	.....	.....	228	.....	s.	.....
12	liq.	.....	.....	180–205	.....	s.	.....
13	liq.	.....	.....	253	.....	s.	.....
14	colorl. liq.	$0.982^{0°}$	.....	172	i.	s.	∞
15	wh. need.	.....	abt. 95; anh.	.....	sl. s.	s.	.....
16	colorl. need.	$1.072^{20°}$	42.5–3.0	183	$6.7^{16°}$; $\infty^{68°}$	∞	v. s.
17	tricl.	.....	250–3	.....	sl. s.	s.	sl. s.
18	.....	.....	.....	.....	sl. s.	sl. s.	.....
19	need.	.....	.....	.....	s.	s.	.....
20	symp.	.....	.....	.....	s.	s.	.....
21	+ F'_2O warts; + $2H_2O$ need.	.....	.....	d. 180	0.5	.....	sl. s.
22	leaf.	.....	180	371	.....	sl. s.	sl. s.
23	prisms f. al.	.....	117	.....	i.	3.3	s.
24	colorl. liq.	1.032	.....	193–4	v. sl. s.	∞	∞
25	colorl. liq.	$1.093^{0°}$	.....	196	v. sl. s.	∞	∞
26	colorl. leaf.	.....	76.5	265.5	v. s. h. sl. s. c.	v. s.	v. s.
27	colorl. liq.	$0.937^{12°}$	.....	139–42	i.	∞	∞
28	yel. need. f. al.	.....	181.5–2.5	403–4	i.	sl. s.	s.; v. s. bz.
29	prisms	.....	263–5 d.	.....	s.	v. sl.	i.
30	monocl.	.....	120–1	.....	s.	v. s.	v. sl. s.
31	liq.	.....	.....	225	.....	.....	.....
32	.....	.....	81	.....	sl. s.	s.	.....
33	leaf.	.....	152–3	417	.....	v. s.	v. s.

No.	Name	Synonyms	Formula	Mol. wt.
1	Phenyl-benzoate		$C_6H_5 \cdot COO \cdot C_6H_5$	198.08
2	benzoic acid (o.)		$C_6H_5 \cdot C_6H_4 \cdot COOH$.	198.08
3	" " (m.)		$C_6H_5 \cdot C_6H_4 \cdot COOH$.	198.08
4	" " (p.)		$C_6H_5 \cdot C_6H_4 \cdot COOH$.	198.08
5	benzylamine		$C_6H_5 \cdot NH \cdot CH_2 \cdot C_6H_5$	183.11
6	carbamate		$C_6H_5 \cdot COONH_2$	137.06
7	carbonate		$(C_6H_5)_2CO_3$	214.08
8	carbylamine chloride	isocyanophenyl chloride	$C_6H_5 \cdot NCCl_2$	173.99
9	cinnamic acid		$C_6H_5CH: C(C_6H_5) COOH$	224.10
10	crotonic acid	phenylmetacrylic acid	$C_6H_5CH: C(CH_3) COOH$	162.08
11	cyanamide		$NC \cdot NHC_6H_5$	118.06
12	cyanide. dihydroquinazoline	See *benzonitrile* orexin	$C_6H_4CH_2N(C_6H_5)CH: N$	208.11
13	disulfide		$(C_6H_5)_2S_2$	218.21
14	ditolylmethane		$C_6H_5 \cdot CH \cdot (C_6H_4 \cdot CH_3)_2$	272.16
15	ether		$C_6H_5 \cdot O \cdot C_6H_5$	170.08
16	ethyl alcohol	benzyl carbinol	$C_6H_5 \cdot CH_2 \cdot CH_2OH$	122.08
17	" " (sec.)		$C_6H_5 \cdot CH(OH) \cdot CH_3$	122.08
18	" amine (β)		$C_6H_5 \cdot CH_2 \cdot CH_2 \cdot NH_2$	121.10
19	" " (α)		$C_6H_5 \cdot CH(NH_2) \cdot CH_3$	121.10
20	" hydrazine (unsym.)		$C_6H_5 \cdot N(C_2H_5) \cdot NH_2$	136.11
21	" " (sym.)		$C_6H_5 \cdot NH \cdot NH \cdot C_2H_5$	136.11
22	" ketone		$C_6H_5 \cdot CO \cdot C_2H_5$	134.08
23	" sulfone		$C_2H_5 \cdot SO_2 \cdot C_6H_5$	170.14
24	ethylene. formanilide	See *cinnamene*	$(C_6H_5)_2NCOH$	197.10
25	glucosazone (d.)		$C_{18}H_{22}O_4N_4$	358.21
26	glycine	anilino acetic acid	$C_6H_5NH \cdot CH_2 \cdot COOH$	151.08
27	glycine carboxylic acid		$(COOH) \cdot C_6H_4NH \cdot CH_2 \cdot COOH$	195.08
28	glyoxylic acid	benzoyl formic acid	$C_6H_5 \cdot CO \cdot COOH$	150.05
29	hydrazine		$C_6H_5 \cdot NH \cdot NH_2$	108.08
30	hydroxycrotonic acid (α)		$C_6H_5 \cdot CH: CH \cdot CHOH \cdot COOH$	178.08
31	hydroxylamine (β)		$C_6H_5 \cdot NH \cdot OH$	109.06
32	isocrotonic acid		$C_6H_5 \cdot CH: CH \cdot CH_2 \cdot COOH$	162.08

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form and color	Sp. gr. H_2O = 1 (A) Air = 1	Melting-point °C	Boiling-point °C	Solubility in gms. per 100 c.c. of		
					Water	Alcohol	Ether
1	colorl. monocl.	.....	68–9	314	v. sl. s.	s.	s.
2	colorl. need.	.....	110–1	343	sl. s. h.	v. s.	.....
3	colorl. leaf.	.....	160–1 (166)	.....	sl. s.	v. s.	v. s.
4	colorl. need.	.....	218–9 (224)	subl.	v. sl. s. h.	v. s.	v. s.
5	pr. f. al.	.....	32	298–300	.....	s.	.....
6	leaf.	.....	141	.....	sl. s.; s. h.	v. s.	v. s.
7	need.	.....	78	301–2	.....	.....	s. CCl_4
8	colorl. oil	.....	.....	209	.....	.....	.....
9	need. f. al.	.....	169–70	subl.	sl. s. h.	s.	s.
10	long.need. or pr.	.....	78	288	.....	s. CS_2	s. bz.
11	need. f. eth.	.....	36–7	.....	sl. s.	s.	s.
12	hex. pl.	.....	95	.....	.....	s.	s.
13	need.	.....	60–1	310 d.	i.	s.	s.
14	need.	.....	55–6	.....	v. s. bz.	s.	v. s.
15	colorl. monocl.	$1.083^{20°}$	28	252–3 (259)	v. sl. s.	5	s.
16	colorl. liq.	1.024	.....	212	$1.6^{20°}$	∞	∞
17	liq.	1.013	.....	202–4	i.	.....	.....
18	wh.-yel. liq.	$0.958^{24°}$	.....	197–8	4	v. s.	v. s.
19	liq.	.....	.....	187	sl. s.	.....	.....
20	oil	.....	.....	.....	.....	.....	.....
21	oil	.....	.....	.....	sl. s.	s.	s.
22	liq.	.....	.....	208–10	.....	.....	.....
23	pl. f. eth.	.....	42	>300	s. h.	s.	s.
24	rhomb.	1.23	73–4	210–20 in. vac.	s. h.	s.	s.
25	yel. need.	.....	217	.....	v. sl. s.	s. h.	.....
26	colorl.	.....	125–7	.....	s.	.....	sl. s.
27	.....	.....	215	.....	sl. s.	.....	.....
28	colorl.	.....	65–6	.....	v. s.	v. s.	.....
29	yel.	$1.097^{23°}$	17.5	243.5 sl. d.	sl. s	∞	∞
30	need.	.....	46	98	.....	.....	.....
31	need.	.....	.....	81–2	2 c.; 10 h.	v. s.	v. s.
32	need.	.....	83–4	302	sl. s. h.	v. s.	v. s.

No.	Name	Synonyms	Formula	Mol. wt.
1	Phenyl-isocyanide.....	phenylcarbylamine	$C_6H_5 \cdot NC$.....	103.05
2	isopropylketone. mercaptan. methylketone.	..... See *thiophenol* See *acetophenone*	$C_6H_5 \cdot CO \cdot CH(CH_3)_2$	148.10
3	methylpyrazolone	.....	$C_{10}H_{10}N_2O$.....	174.10
4	mustard oil.....	phenyl isothio-cyanate	$C_6H_5 \cdot NCS$.....	135.11
5	naphthalene (α)	.....	$C_{10}H_7 \cdot C_6H_5$.....	204.10
6	" (β)	.....	$C_{13}H_7 \cdot C_6H_5$.....	204.10
7	naphthylamine (α)	.....	$C_{10}H_7 \cdot NH \cdot C_6H_5$...	219.11
8	" (β)	.....	$C_{10}H_7 \cdot NH \cdot C_6H_5$...	219.11
9	naphthyl ketone (α)	.....	$C_{10}H_7 \cdot CO \cdot C_6H_5$...	232.10
10	" " (β)	.....	$C_{10}H_7 \cdot CO \cdot C_6H_5$...	232.10
11	nitramine.....	.....	$C_6H_5 \cdot NH(NO_2)$....	138.06
12	oxydisulfide....	.....	$(C_6H_5)_2S_2O_2$.....	250.21
13	phosphine.....	.....	$C_6H_5 \cdot PH_2$.....	110.08
14	propiolic acid...	.....	$C_6H_5 \cdot C : C \cdot COOH$.	146.05
15	propyl alcohol (γ)	.....	$C_6H_5 \cdot (CH_2)_2 \cdot CH_2OH$	136.10
16	" " (sec.)	.....	$C_6H_5 \cdot CH(OH) \cdot C_2H_5$	136.10
17	propylglycolic acid	.....	$C_6H_4 \cdot C_3H_7 \cdot CHOH \cdot COOH$	194.11
18	propylketone...	.....	$C_6H_5 \cdot CO \cdot C_3H_7$....	148.10
19	pyridine (α)....	.....	$C_6H_5 \cdot C_5H_4N$.....	155.08
20	" (β)....	.....	$C_6H_5 \cdot C_5H_4N$.....	155.08
21	" (γ)....	.....	$C_6H_5 \cdot C_5H_4N$.....	155.08
22	quinoline (α)...	.....	$C_6H_5 \cdot C_9H_6N$.....	205.09
23	quinoline (o.)...	.....	$C_9H_6N \cdot C_6H_5$.....	205.09
24	" (p.)...	.....	$C_9H_6N \cdot C_6H_5$.....	205.09
25	salicylate.....	salol.....	$HO \cdot C_6H_4 \cdot COO \cdot C_6H_5$	214.08
26	salicylic acid....	.....	$C_6H_4(OC_6H_5) \cdot COOH$	214.08
27	semicarbazide (1)	.....	$C_6H_5 \cdot NH \cdot NH \cdot CO \cdot NH_2$	151.10
28	sulfide.....	.....	$(C_6H_5)_2S$.....	186.14
29	thiourea.....	.....	$CS(NH_2)NH \cdot C_6H_5$.	152.14
30	toluene (o.).....	.....	$C_6H_5 \cdot C_6H_4 \cdot CH_3$...	168.10
31	" (m.).....	.....	$C_6H_5 \cdot C_6H_4 \cdot CH_3$...	168.10
32	" (p.).....	.....	$C_6H_5 \cdot C_6H_4 \cdot CH_3$...	168.10
33	totyl ketone (o.)	.....	$C_6H_5 \cdot CO \cdot C_6H_4 \cdot CH_3$	196.10
34	" " (m.)	.....	$C_6H_5 \cdot CO \cdot C_6H_4 \cdot CH_3$	196.10
35	" " (p.)	.....	$C_6H_5 \cdot CO \cdot C_6H_4 \cdot CH_3$	196.10
36	urea.....	.....	$C_6H_5 \cdot NH \cdot CO \cdot NH_2$	136.19
37	urethane.....	ethylphenyl carbamate	$C_6H_5 \cdot NH \cdot COO \cdot C_2H_5$	165.10
	Phenylene diamine.	See *diamino-benzene*		
38	Phloretic acid....	p-hydroxyhydratropic acid	$C_6H_4(OH) \cdot CH(CH_3) COOH$	166.08

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form and color	Sp. gr. $H_2O = 1$ (A)Air = 1	Melting-point °C	Boiling-point °C	Solubility in gms. per 100 c.c. of		
					Water	Alcohol	Ether
1	color.-grn. liq.	0.978	.....	165–6	dec.	dec.	s.
2	.....	.....	.....	209–17	.....	.....	.....
3	pr.	.....	127	$287^{205mm.}$	s. h.	s. h.	v. sl. s.
4	liq.	1.138	–21	221	i.	s.	s.
5	colorl. liq.	.....	.....	324–5	.....	v. s.	v. s.
6	colorl. leaf	.....	102–2.5	345	.....	v. s.	v. s.
7	colorl. leaf.	.....	60–2	.....	v. s. bz.	v. s.	v. s.
8	need.	.....	107.5–8.0	395	s. chl.	s.	s.
9	rhombic	.....	75.5	385	i.	$2.4^{12°}$	.....
10	need.	.....	82	.....	i.	2 c.	.....
11	leaf. f. lgr.	.....	46–6.5	exp.	s.	v. s.	.....
12	.....	.....	36	.....	.....	s. h.	s.
13	.....	1.001$^{15°}$	.....	160–1	.....	.....	.....
14	long. need.	.....	136–7	subl.	v. sl. s.	v. s.	v. s.
15	liq.	1.007$^{15°}$	<–18	235, $119^{12mm.}$	s.	∞	∞
16	liq.	$0.994^{23°}_{0}$	.....	212	.....	.....	.....
17	.....	.....	158	.....	.....	.....	.....
18	liq.	1.992$^{15°}$	.....	220–2	.....	.....	.....
19	liq.	.....	.....	269–71	i.	v. s.	v. s.
20	oil	.....	.....	269.5–70.5	i.	v. s.	v. s.
21	leaf. f. w.	.....	77	274–5	v. sl. s. h.	s.	s.
22	need. f. al.	.....	84–6	300	sl. s.	v. s.h.	v. s.
23	thk. fluor. oil.	.....	.....	270–6 $^{80mm.}$	.....	s.	s.; s. bz.
24	pl. f. al.	$1.194^{20°}$	110–1	$260^{77mm.}$	v. sl. s.	s.	s.
25	colorl.	$1.261^{30°}$	42.5	.....	v. sl. s.	$21.5^{25°}$	v. s.
26	need.	.....	159	.....	i.	s. $CHCl_3$	.....
27	lvs. f. al.	.....	172	..... s. h.	sl. s. c.;	v. s.	.....
28	liq.	$1.119^{15°}_{15°}$	.....	296	i.	s.	∞ ; ∞ bz.
29	need.	.....	154	.....	1:400	$5.66^{25°}$	.....
30	colorl. liq.	.....	.....	258–60	i.	s.	s.
31	colorl. liq.	$1.031^{0°}$	.....	272–7	i.	s.	s.
32	colorl. liq.	$1.015^{27°}$	–2–3	263–7	i.	s.	s.
33	colorl. liq.	.....	<–18	315–6	.....	.....	.....
34	colorl. liq.	$1.088^{18°}$	.....	314–6	∞ bz.	v. s.	v. s.
35	monocl.	.....	59–60*	326	v. s. bz.	s.	v. s.
36	monocl.	.....	146.5–7.0	.....	sl. s. c.; v. s. h.	v. s.	v. s.
37	need. f. w.	.....	51.5–2.0	.....	v. sl. s.	v. s.	v. s.
38	monocl. f. eth.	.....	128–30	.....	s. h.	s.	s.

* A hexagonal form melts at 55° C

No.	Name	Synonyms	Formula	Mol. wt.
1	Phloretin		$C_{15}H_{14}O_5$	274.11
2	Phloridzin		$C_{21}H_{24}O_{10} + 2H_2O$	472.22
3	Phloroglucinol	trihydroxybenzene (3, 1, 5)	$C_6H_3 \cdot (OH)_3 + 2H_2O$	162.06
4	triethyl ether		$C_6H_3 \cdot (OC_2H_5)_3$	210.14
5	trimethyl ether		$C_6H_3 \cdot (OCH_3)_3$	168.10
6	trioxime		$C_6H_6(NOH)_3$	171.10
7	Phlorol		$C_8H_{10}O$	122.08
8	Phloron	xyloquinone	$(CH_3)_2C{:}\ CH{-}CO$	138.11
9	Phosgene. See	*carbonyl chloride*		
10	Phosphenylchloride		$C_6H_5PCl_2$	178.98
11	Phosphobenzene		$C_6H_5 \cdot P{:}\ P \cdot C_6H_5$	216.13
12	Phthalamide (o.)		$C_6H_4(CONH_2)_2$	164.08
13	Phthalanil		$C_6H_4O_2{:}\ NC_6H_5$	223.07
14	Phthalic acid		$C_6H_4 \cdot (COOH)_2$ (o.)	166.05
15	aldehyde		$C_6H_4 \cdot (CHO)_2$ (o.)	134.05
16	anhydride		$C_6H_4 \cdot (CO)_2O$ (c.)	148.03
17	Phthalide		$C_8H_6O_2$	134.05
18	Phthalimide		$C_6H_4{:}\ (CO)_2{:}\ NH$	147.05
19	Phthalonic acid		$C_6H_4(COOH)CO \cdot COOH$	194.05
20	Phthalophenone	triphenylcarbinol-o-carboxylic anhyd.	$(C_6H_5)_2{:}\ C \cdot C_6H_4 \cdot COO$	286.11
21	Phthalylchloride (o.)		$C_6H_4(COCl)_2$	202.95
22	" (m.)		$C_6H_4(COCl)_2$	202.95
23	" (p.)		$C_6H_4(COCl)_2$	202.95
24	Picene		$C_{22}H_{14}$	278.11
25	Picoline (α)	methyl pyridine (2)	$CH_3 \cdot C_5H_4N$	93.06
26	" (β)	" " (3)	$CH_3 \cdot C_5H_4N$	93.06
27	" (γ)	" " (4)	$CH_3 \cdot C_5H_4N$	93.06
28	Picolinic acid (2)	pyridine carbonic acid (2)	C_5H_4NCOOH	123.03
29	Picramic acid (4, 6, 2)	dinitroaminophenol (4, 6, 2, 1)	$(NO_2)_2(NH_2) \cdot C_6H_2 \cdot OH$	199.06
30	Picramide	trinitroaniline	$NH_2 \cdot C_6H_2 \cdot (NO_2)_3$ (1, 2, 4, 6)	228.06
31	Picric acid	trinitrophenol (1, 2, 4, 6)	$HO \cdot C_6H_2 \cdot (NO_2)_3$ (1, 2, 4, 6)	229.03
32	Picryl chloride		$Cl \cdot C_6H_2 \cdot (NO_3)_3$	295.50
33	Pilocarpine		$C_{11}H_{16}O_2N_2$	208.14
34	hydrochloride		$C_{11}H_{16}O_2N_2 \cdot HCl$	244.6
35	nitrate		$C_{11}H_{16}O_2N_2 \cdot HNO_3$	271.1
36	Pimaric acid		$C_{20}H_{30}O_2$	302.2
37	Pinacoline		$CH_3 \cdot CO \cdot C(CH_3)_3$	100.1

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form and color	Sp. gr. $H_2O = 1$ (A)Air = 1	Melting-point °C	Boiling-point °C	Solubility in gms. per 100 c.c. of		
					Water	Alcohol	Ether
1	sm. leaf.	.....	253–5	.....	sl. s. h.	∞ acet. a.	v. sl. s.
2	need.	$1.430^{19°}$	108–9*	.....	0.1 c.; v. s. h.	v. s.	v. sl. s.
3	rhombic	.....	anh. 217–9	subl. d.	v. s.	v. s.	v. s.
4	colorl.	.....	43	.....	i.	v. s.	v. s.
5	colorl. pr.	.....	52	255.5	.....	v. s.	v. s.
6	powd.	.....	exp. 155	.....	v. sl. s.	v. sl. s.	s. chl.; s. acet. a.
7	liq.	$1.0374^{12°}$	.....	220	.....	.....	.....
8	pa. yel.	$0.885^{20°}$	28	198.5	.....	s.	s.
9							
10	liq.	$1.319^{20°}$	.....	224.6	d.	∞ bz.	∞ CS_2
11	pa. yel. powd.	.....	149–50	.....	i.	i.	i.
12	colorl. rh'b'dr.	.....	219–20	.....	i.	i.	i.
13	need.	.....	205	subl.	i.	s.	.....
14	colorl. rhomb.	1.585	184 d.	.....	$0.54^{14°}$; $18^{99°}$	v. s.	$0.69^{15°}$
15	.....	.....	56	.....	s.	s.	s.
16	colorl. pr.	$1.527^{4°}$	128	284.5	v. sl. s.	s.	sl. s.
17	need. f. w.	.....	73	290	v. sl. s.	v. s.	.....
18	need.	.....	228.5	subl.	v. sl. s.	v. sl. s. bz.	sl. s.
19	cryst.	.....	145	.....	s.	s.	s.
20	leaf.	.....	145	.....	.....	s.	.....
21	colorl. liq.	$1.4089^{20°}$	0	281.5	d.	d.	s.
22	cryst.	.....	41	276	.....	.....	.....
23	need.	.....	78	259	.....	.....	.....
24	colorl.	.....	364	518–20	sl. s. h. bz.	sl. s. chl.	.....
25	colorl. liq.	0.950	.....	129	v. s.	∞	∞
26	colorl. liq.	0.961	.....	143.5	∞	∞	∞
27	colorl. liq.	0.957	.....	143.1	∞	∞	∞
28	need. f. w.	.....	136	subl.	v. s.	v. s.	v. sl. s.
29	monocl. f. chl.	.....	168–9	.....	$0.14^{22°}$	s.	sl. s.; v. s. bz.
30	yel. tab.	.....	188	.....	i.	i.	s. acet. a.
31	yel. leaf. f. w.	$1.767^{19°}$	122	exp.	$1.22^{20°}$ $6.33^{100°}$	$5.92^{14.8°}$	$1.08^{13°}$
32	yel. pr.	.....	81–2	.....	i.	s.	s.
33	colorl. need.	.....	34	.....	v. s.	v. s.	sl. s.
34	deliq. cryst.	.....	200–4	.....	333	43; 10 abs.	i.; sl. s. chl.
35	prisms	.....	178	.....	$16^{20°}$	$6.2^{60°}$	i.
36	.....	.....	148	.....	i.	s.	.....
37	colorl. liq.	0.800	.....	106	v. sl. s.	s.	s.

* Anhydrous form melts about 170° C. with decomposition.

No	Name	Synonyms	Formula	Mol. wt.
1	Pinacolyl alcohol	.....	$(CH_3)_3C \cdot CH(OH) CH_3$	102.11
2	Pinacone	.....	$(CH_3)_2 \cdot C(OH) \cdot C(OH) \cdot (CH_3)_2$	118.11
3	Pinene (α)	.....	$C_{10}H_{16}$	136.13
4	hydrochloride	.....	$C_{10}H_{16} \cdot HCl$	172.59
5	Pinol	.....	$C_{10}H_{16}O$	152.13
6	Piperazine See	*diethylenediamine*		
7	Piperic acid	.....	$C_{12}H_{10}O_4$	218.08
8	Piperidine	hexahydropyridine	$C_5H_{11}N$	85.10
9	Piperine	.....	$C_5H_{10}N \cdot CO \cdot C_9H_4 \cdot C_6H_3 : O_2 : CH_2$	285.16
10	Piperonal	heliotropin	$CH_2 \cdot O_2 \cdot C_6H_3 \cdot CHO$	150.05
11	Piperonyl alcohol	.....	$CH_2(O_2)C_6H_3 \cdot CH_2OH$	152.06
12	Piperonylic acid	.....	$C_8H_6O_4$	166.05
13	Piperylene	.....	$CH_2 \quad CH \cdot CH_2 \cdot CH \quad CH_2$	68.06
14	Pivalic acid. See	*trimethylacetic acid*		
15	Populin	benzoyl salicin	$C_{20}H_{22}O_8 + 2H_2O$	426.21
16	Prehnitic acid (1, 2, 3, 4)	.....	$C_6H_2(COOH)_4$	254.05
17	Propane	.....	$CH_3 \cdot CH_2 \cdot CH_3$	44.06
18	Propargyl acetate	.....	$CH_3 \cdot COO \cdot C_3H_3$	98.05
19	alcohol	.....	$CH \vdots C \cdot CH_2OH$	56.03
20	Propiolic acid	.....	$CH \vdots C \cdot COOH$	70.02
21	Propionaldoxime	.....	$C_2H_5 \cdot CH : NOH$	73.06
22	Propionamide	.....	$C_2H_5 \cdot CO \cdot NH_2$	73.06
23	Propionanilide	.....	$C_6H_5 \cdot NH \cdot CO \cdot C_2H_5$	149.10
24	Propionic acid	.....	$CH_3 \cdot CH_2 \cdot COOH$	74.05
25	aldehyde	.....	$CH_3 \cdot CH_2 \cdot CHO$	58.05
26	anhydride	.....	$[CH_3 \cdot CH_2 \cdot CO]_2O$	130.08
27	Proponal	dipropyl barbituric acid	$C_{10}H_{16}O_3N_2$	212.14
28	Propyl acetate	.....	$CH_3 \cdot COO \cdot C_3H_7$	102.08
29	acetylene	.....	$C_3H_7 \cdot C \vdots CH$	68.06
30	alcohol	.....	$CH_3 \cdot CH_2 \cdot CH_2OH$	60.06
31	amine (n.)	.....	$CH_3 \cdot CH_2 \cdot CH_2NH_2$	59.08
32	aniline	.....	$C_6H_5 \cdot NH(C_3H_7)$	135.11
33	benzene	.....	$C_6H_5 \cdot CH_2 \cdot CH_2 \cdot CH_3$	120.10
34	benzoate	.....	$C_6H_5 \cdot COO \cdot C_3H_7$	164.10
35	benzoic acid (o.)	.....	$C_3H_7 \cdot C_6H_4 \cdot COOH$	164.10
36	" " " (p.)	.....	$C_3H_7 \cdot C_6H_4 \cdot COOH$	164.10
37	bromide	.....	$CH_3 \cdot CH_2 \cdot CH_2Br$	122.97
38	butyrate	.....	$C_3H_7 \cdot COO \cdot C_3H_7$	130.11
39	carbamate	.....	$NH_2 \cdot COOC_3H_7$	103.08
40	chloride	.....	$CH_3 \cdot CH_2 \cdot CH_2Cl$	78.51
41	chloride (sec.)	.....	$CH_3 \cdot CHCl \cdot CH_3$	78.51
42	cyanide	butyro-nitrile	$CH_3 \cdot CH_2 \cdot CH_2 \cdot CN$	69.14
43	ether	.....	$C_3H_7 \cdot O \cdot C_3H_7$	102.11
44	formate	.....	$H \cdot COO \cdot C_3H_7$	88.06
45	hexyl ketone	.....	$C_3H_7 \cdot CO \cdot C_6H_{13}$	156.16

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form and color	Sp. gr. $H_2O = 1$ (A)Air = 1	Melting-point °C	Boiling-point °C	Solubility in gms. per 100 c.c. of		
					Water	Alcohol	Ether
1	need.	$0.8347^{0°}$	5.45	120–1	.....	s.	.....
2	colorl. need.	0.967	35–8	172–3	s. c.; v. s. h.	v. s.	.....
3	colorl. liq.	$0.859^{20°}$	.....	156	v. sl. s.	∞ abs.	∞
4	colorl.	.....	125	.....	i.	v. s.	s.
5	.....	$0.9420^{20°}$	184	.....	.....	s.	.....
6							
7	yel. need.	.....	216–7	.....	v. sl. s.	s. h.	s.
8	colorl. liq.	$0.862^{20°}$	–17	106	∞	∞	.....
9	colorl. monocl.	.....	129–30	.....	v. sl. s. c.	6.7; $23^{60°}$	2.8
10	need, f. w.	.....	37	263	0.2 c.	v. s.	v. s.
11	cryst.	.....	51	d.	sl. s.	∞	∞
12	need. f. w. or al.	.....	228	subl.	sl. s. h.	s. h.	.....
13	liq.	.....	.....	42	.....	.....	.....
14	colorl. need.	.....	anh. 180	.....	0.05 c.	s.	s.
15	pr.	.....	237–50	d.anh.	s.	.....	.....
16							
17	colorl. gas	1.558 (A)	.....	–38–9	6.5c.c.$^{18°}$	790c.c.$^{17°}$	926c.c.$^{17°}$
18	colorl. liq.	$1.005^{20°}$	.....	124.5	.....	s.	s.
19	colorl. liq.	$0.972^{20°}$	.....	114–5	s.	∞	∞
20	need.	.....	6	144 d.	s.	s.	s.
21	..... colorl. leaf.	$0.926^{20°}$ $0.960^{80°}$	21.5 79	131–5 213	..... s.	..... s.	..... s.
22	colorl.	.....	104	.....	$0.42^{24°}$	v. s.	v. s.
23	leaf.						
24	colorl. liq.	$0.987^{20°}$	–22	140.7	∞	∞	∞
25	colorl. liq.	$0.870^{20°}$	–81	48.8	$20^{20°}$	∞	∞
	colorl. liq.	1.017	.....	168.6	dec.	dec.	.....
26	colorl.	.....	145	.....	0.06 c.; $1.4^{100°}$	v. s.	v. s.
27							
28	colorl. liq.	$0.891^{18°}$	.....	102	$2.36^{20°}$	∞	∞
29	colorl. liq.	.....	.....	48–9	i.	.....	s.
30	colorl. liq.	$0.804^{20°}$	.....	97.4	∞	∞	∞
31	colorl. liq.	$0.719^{20°}$	.....	49	s.	.....	.....
32	liq.	$0.949^{18°}$	.....	222	.....	.....	.....
33	colorl. liq.	$0.862^{20°}$	.....	158	i.	s.	s.
34	colorl. liq.	1.032	.....	229.5	v. sl. s.	∞	∞
	leaf. f. al.	.....	58	272	s.	v. s.	v. s.
35	colorl.	.....	.....	140	sl. s. h.	v. s.	v. s.
36	leaf.						
37	liq.	1.364	.....	71.5	$0.25^{20°}$	∞	.....
38	colorl. liq.	0.879	.....	143	.....	∞	∞
39	colorl. pr.	.....	53 (60)	194–5	v. s.	v. s.	s.
40	colorl. liq.	$0.8954^{0°}$	.....	46.5	$0.27^{20°}$	∞	∞
41	colorl. liq.	$0.859^{20°}$	.....	36.5	.....	∞	∞
42	.....	$0.794^{20°}$	.....	118	sl. s.	∞	∞
43	colorl. liq.	$0.744^{21°}$	.....	90.7	s.	∞	∞
44	colorl. liq.	$0.9091^{20°}$	.....	81	$2.87^{20°}$	∞	∞
45	colorl. liq.	$0.824^{20°}$	–9	267	v. sl. s.	∞	∞

No.	Name	Synonyms	Formula	Mol. wt.
1	Propyl-hydroxylamine (β)	.....	$C_3H_7 \cdot NHOH$	75.08
2	iodide	.....	$CH_3 \cdot CH_2 \cdot CH_2I$	169.99
3	isovaleriate	.....	$(CH_3)_2 \cdot CH \cdot CH_2 \cdot COO \cdot C_3H_7$	144.13
4	mercaptan	.....	$CH_3 \cdot CH_2 \cdot CH_2SH$ ..	76.13
5	naphthylamine (α)	.....	$C_{10}H_7 \cdot NH \cdot C_3H_7$ ...	185.13
6	nitramine	.....	$C_3H_7 \cdot NH(NO_2)$	104.08
7	nitrate	.....	$C_3H_7 \cdot NO_3$	105.06
8	nitrite	.....	$C_3H_7 \cdot NO_2$	89.06
9	phenol (m.)	.....	$C_3H_7 \cdot C_6H_4 \cdot OH$	136.10
10	phenyl ketone ..	butyro-phenone ..	$C_3H_7 \cdot CO \cdot C_6H_5$	148.10
11	propionate	.....	$C_2H_5 \cdot COO \cdot C_3H_7$ ...	116.10
12	pyridine (α) ...	.....	$C_3H_7 \cdot C_5H_4N$	121.10
13	" (α), (iso)	.....	$C_3H_7 \cdot C_5H_4N$	121.10
14	" (γ), (iso)	.....	$C_3H_7 \cdot C_5H_4N$	121.10
15	sulfide	.....	$(C_3H_7)_2S$	118.18
16	tartrate	.....	$C_4H_4O_6 \cdot (C_3H_7)_2$	234.14
17	urea	.....	$C_3H_7 \cdot NH \cdot CO \cdot NH_2$	102.10
18	Propylene	.....	$CH_3 \cdot CH : CH_2$	42.05
19	bromide	dibrompropane ...	$CH_3 \cdot CHBr.CH_2Br$.	201.88
20	chloride	dichlorpropane ...	$CH_3 \cdot CHCl \cdot CH_2Cl$.	112.98
21	glycol (α)	.....	$CH_3 \cdot CH(OH) \cdot CH_2OH$	76.06
22	oxide	.....	$CH_3 \cdot (CH \cdot CH_2) \cdot O$.	58.05
23	Protocatechuic ...	.....	$(HO)_2 \cdot C_6H_3 \cdot COOH + H_2O$	172.06
24	acid (3, 4, 1)			
25	aldehyde (3, 4, 1)	.....	$(HO)_2 \cdot C_6H_3 \cdot CHO$ ..	138.05
26	Pseudo-cumene ..	trimethyl benzene (uns.)	$C_6H_3 \cdot (CH_3)_3$ (1, 2, 4)	120.10
27	Pseudo-cumidine .	.....	$(CH_3)_2 \cdot C_6H_2 \cdot NH_2$ (1, 2, 4, 5)	135.11
28	Pseudo-morphine .	.....	$C_{17}H_{19}NO_4$	301.16
29	Pseudo-tropine ...	.....	$C_8H_{15}NO$	141.13
30	Pulegone	.....	$C_{10}H_{16}O$	152.13
31	Purine	.....	$C_5H_4N_4$	120.06
32	Purpurine (1, 2, 4)	trihydroxyanthra-quinone	$C_6H_4 \cdot (CO)_2 \cdot C_6H(OH)_3$	256.06
33	Purpurxanthine (1, 3)	.....	$C_6H_4(CO)_2C_6H_2(OH)_2$	240.06
34	Pyrantin	.....	$C_{12}H_{13}O_3N$	219.11
35	Pyrazine	.....	$C_4H_4N_2$	80.05
36	Pyrazole	.....	$C_3H_4N_2$	68.05
37	Pyrazoline	.....	$C_3H_6N_2$	70.06
38	Pyrazolone	.....	$CO \cdot CH_2 \cdot CH : N \cdot NH$	84.05
39	Pyrene	.....	$C_{16}H_{10}$	202.08
40	Pyridazine	.....	$C_4H_4N_2$	80.04
41	Pyridine	.....	C_5H_5N	79.05
42	pentacarboxylic acid	.....	$C_5N(COOH)_5 + 2H_2O$ or $3H_2O$	335.08 or 353.10

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form and color	Sp. gr. $H_2O = 1$ (A)Air = 1	Melting-point °C	Boiling-point °C	Solubility in gms. per 100 c.c. of		
					Water	Alcohol	Ether
1	need. f. eth.	.....	abt. 46	.....	.....	.....	.....
2	.....	1.748	.....	102.4	$0.11^{20°}$	∞	∞
3	colorl. liq.	.....	.....	153–6	i.	∞	∞
4	liq.	.....	.....	67–8	v. sl. s.	s.	s.
5	oil	.....	.....	abt. 317	i.	.....	.....
6	.....	$1.103^{18°}$	−21	$128^{40mm.}$	sl. s.	v. s.	v. s.
7	liq.	1.063	.....	110.5	.....	s.	s.
8	liq.	$0.935^{21°}$	.....	57	.....	s.	s.
9	colorl.	.....	26	228	v. sl. s.	s.	.....
10	colorl. liq.	$1.009^{0°}$	8.5	220–2	i.	s.	.....
11	colorl. liq.	.....	.....	122.4	0.5	∞	∞
12	liq.	$<H_2O$	.....	165–8	.....	.....	.....
13	.....	$0.9342^{0°}$	.....	158–9	sl. s.	.....	.....
14	pl.	pl.	205	.....	.....	.....	.....
15	.....	0.814	.....	141.5–2.5	i.	s.	s.
16	liq.	$1.134^{20°}$	.....	303	i.	v.s .	v. s.
17	colorl.	.....	107	.....	s.	.....	.....
18	colorl. gas.	1.498 (A)	.....	−50.2	44.6 c.c.	1250 c.c.	.....
19	colorl. liq.	1.931	.....	141.6	$0.25^{20°}$	s.	v. s.
20	colorl. liq.	1.166	.....	96.8	$0.27^{20°}$	v. s.	v. s.
21	colorl. liq.	$1.051^{0°}$	.....	188	.....	.....	.....
22	colorl. liq.	0.859	35	.....	33	∞	∞
23	colorl.	$1.542^{4°}$	199 d.	.....	s.	v. s.	s.
24	monocl.	anh.					
25	colorl. tab.	.....	153–4	dec.	5	v. s.	v. s.
26	colorl. liq.	$0.879^{20°}$	−57.5	169.8	i.	.....	.....
27	colorl. need. f. al.	.....	66	234–5	.....	s.	.....
28	.....	.....	245 d.	.....	.....	i.	i.
29	rh'b'dr.	.....	106	241–3	.....	s. chl.	sl. s.
30	colorl. liq.	0.932	.....	221–2	i.	∞	∞
31	mic. need. f. al.	.....	216–7	d.	v. s.	s.	v. sl. s.
32	red. need. f. al.	.....	256	d.	s.	s.	s.
33	yel. need. f. acet. a.	.....	262–3	subl.	.....	.....	.....
34	pr. f. al.	.....	155	.....	$0.075^{17°}$; $1.2^{100°}$	v. s. h.	i.
35	pr. f. w.	.....	47	118	∞	v. s.	v. s.
36	need. f. al.	.....	69.5–70.0	186–8	v. s.	v. s.	v. s.
37	colorl. liq.	.....	.....	144	∞	∞	.....
38	need.	.....	164	.....	s.	s.	sl. s.
39	monocl. tab.	.....	148–9	.....	i.	1.4	v. s.
40	colorl. liq.	$1.111^{18°}_{4°}$	−8	206	∞	v. s.	v. s.
41	liq.	0.990	.....	115	∞	∞	∞
42	f. eth. $2H_2O$ f. w. $3H_2O$	.....	d. 220	.....	v. s.	.....	v. sl. s.

No.	Name	Synonyms	Formula	Mol. wt.
1	Pyridine sulfonic acid (3)	.....	$C_5H_4N \cdot SO_3H$	159.1
2	tricarboxylic acid (1, 2, 3, 4)	carbocinchomeronic	$C_5H_2N(COOH)_3 + 1\frac{1}{2}H_2O$	238.0
3	tricarboxylic acid (1, 2, 4, 5)	See *berberonic acid*		
4	tricarboxylic acid (1, 3, 4, 5)	β-carbocinchomeronic	$C_5H_2N(COOH)_3 + 3H_2O$	265.1
5	tricarboxylic acid (1, 2, 4, 6)	trimesitinic acid..	$C_5H_2N(COOH)_3 + 2\frac{1}{2}H_2O$	256.0
6	Pyridone. See	*hydroxypridine*		
7	Pyrimidine.....	m-diazine.....	$CH:CH \cdot CH:N \cdot CH:N$	80.0
8	Pyrocatechin.	See *catechol*		
9	Pyrocoll.....	.....	$C_4H_3 \cdot N(CO)_2 \cdot NC_4H_3$	186.0
10	Pyrogallol (1, 2, 3)	pyrogallic acid...	$C_6H_3(OH)_3$.....	126.0
11	carboxylic acid (1, 2, 3, 4)	.....	$C_6H_2(OH)_3COOH + H_2O$	188.0
12	dimethylether ..	.....	$C_6H_2 \cdot OH(OCH_3)_2$..	154.0
13	trimethylether..	.....	$C_6H_2 \cdot (OCH_3)_3$.....	168.1
14	Pyromellitic acid.	benzene tetracarbonic acid (1, 2, 4, 5)	$C_6H_2 \cdot (COOH)_4 + 2H_2O$	290.0
15	Pyromucic acid ..	.....	$C_4H_3O \cdot COOH$.....	112.0
16	Pyrone.....	.....	$C_5H_4O_2$.....	96.0
17	Pyrotartaric acid.	.....	$CH_3 \cdot CH(COOH) \cdot CH_2 \cdot COOH$	132.0
18	Pyrotritaric acid.	See *uvic acid*		
19	Pyroxylin.....	.....	$C_{12}H_{14}(ONO_2)_6O_4$...	594.1
20	Pyrrol.....	.....	$C_4H_4:NH$.....	67.0
21	carboxylic acid(α)	.....	$C_4H_3NH(COOH)$...	111.0
22	Pyrrolidine.....	pentazane.....	$C_4H_8:NH$.....	71.0
23	Pyrroline.....	.....	$C_4H_7:NH$.....	69.0
24	Pyruvic acid.....	pyroracemic acid..	$CH_3 \cdot CO \cdot COOH$...	88.0
25	Quercite (d.).....	.....	$C_6H_7 \cdot (OH)_5$.....	164.1
26	Quercetin.....	.....	$C_{15}H_{10}O_7 + 2H_2O$ ..	338.1
27	Quercitrine.....	.....	$C_{21}H_{22}O_{12} + 2H_2O$	502.2
28	Quinaldine. See	*methylquinoline* (2)		
29	Quinazoline.....	.....	$C_6H_4CH:N \cdot CH:N$	130.0
30	Quinhydrone.....	.....	$C_6H_4 \cdot O_2 \cdot C_6H_4 \cdot (OH)_2$	218.0
31	Quinic acid.....	.....	$(HO)_4 \cdot C_6H_7 \cdot COOH$	192.1
32	Quinine.....	.....	$C_{20}H_{24}O_2N_2$.....	324.2
33	hydrochloride...	.....	$C_{20}H_{24}O_2N_2 \cdot HCl + 2H_2O$	396.7

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form and color	Sp. gr. H_2O = 1 (A)Air = 1	Melting-point °C	Boiling-point °C	Solubility in gms. per 100 c.c. of		
					Water	Alcohol	Ether
1	need.	.....	.....	.....	v. s.	v. sl. s.	i.
2	rhomb.	.....	249–50	.....	$1.2^{15°}$	sl. s.	i.
3							
4	leaf.	.....	261	.....	s. h.	.....	.....
5	.....	.....	244	.....	v. s.	.....	.....
6							
7	cryst.	.....	22	124	s.	s.	.....
8							
9	yel. leaf.	.....	268.9	subl.	i.	v. sl. s.	v. sl. s.
10	need. or leaf.	.....	133	293 d.	v. s.	$100^{25°}$	v. s.
11	need.	.....	195–200	subl.	sl. s.	v. s.	s.
12	.....	.....	51–2	253	.....	.....	.....
13	colorl. need.	.....	47	235 (241)	.....	v. s.	v. s.
14	triclinic tab.	.....	anh. 264 d.	.....	$14.2^{16°}$	v. s.	.....
15	monocl.	.....	132–4	subl.	$3.6^{15°}$; v. s. h.	v. s.	v. s.
16	prisms	.....	32.5	315	v. sl. s.	s.	v. s.
17	triclinic	1.411	112 (118)	.....	v. s.	v. s.	v. s.
18							
19	.....	.....	exp.l	.....	.....	i. al. eth. mxt.	
20	colorl. liq.	$0.967^{n°}$	.....	130	i.	v. s.	v. s.
21	pr.	.....	192 d.	.....	s.	s.	s.
22	colorl. liq.	$0.852^{22.5°}$	.....	87.5–8.5	∞	∞	∞
23	liq.	$0.910^{20°}$	.....	90	v. s.	∞	∞
24	colorl.	$1.288^{18°}$	13.6	165 sl. d.	∞	∞	∞
25	colorl. monocl.	$1.585^{13°}$	231 (225)	.....	10 c.	sl. s.	i.
26	yel. need.	.....	313–4 d.	subl.	0.35	.....	.....
27	yel. need. or leaf.	.....	168 d.	.....	v. sl. s.	sl. s.	0.8
28							
29	.....	.....	48	243	.....	.....	.....
30	dk. gr'n. pr.	.....	.....	subl.	s. h.	v. s.	v. s.
31	colorl. monocl.	1.637	161.6	dec.	$40^{9°}$	s.	v. sl. s.
32	silky need. f. bz.	.....	174–5	.....	$0.057^{25°}$	166	22
33	silky need.	.....	156–190	.....	$5.6^{25°}$	$166^{25°}$	$0.42^{25°}$

No.	Name	Synonyms	Formula	Mol. wt.
1	Quinine sulfate		$(C_{20}H_{24}O_2N_2)_2H_2SO_4 + 7\,H_2O$	872.61
2	Quinizarin	p-dihydroxyanthraquinone	$C_6H_4(CO)_2C_6H_2(OH)_2$	240.06
3	Quinol	hydroquinone	$C_6H_4\cdot(OH)_2$ (p.)	110.05
4	Quinoline		C_9H_7N	129.06
5	Quinolinic acid	pyridine dicarbonic acid (2, 3)	$C_5H_3N\cdot(COOH)_2$	167.05
6	Quinone	benzoquinone	$C_6H_4\cdot O_2$	108.03
7	chlorimide		$C_6H_4N(Cl)O$	141.50
8	dichlordiimide		$C_6H_4(NCl)_2$	174.96
9	dioxime		$C_6H_4(NOH)_2$	138.06
10	Quinoxaline	quinazine	$C_6H_4N{:}\,CHCH{:}\,N$	130.09
11	Racemic acid		$[CH(OH)\cdot COOH]_2 + H_2O$	168.06
12	Raffinose		$C_{18}H_{32}O_{16} + 5H_2O$	594.34
13	Resorcinol	dihydroxybenzene (m.)	$C_6H_4\cdot(OH)_2$ (m.)	110.05
14	dimethyl ether		$C_6H_4(OCH_3)_2$	138.08
15	methyl ether		$HO\cdot C_6H_4\cdot OCH_3$	124.06
16	Resorcylic acid (α) COOH, $(OH)_2$ 1, 3, 5		$C_6H_3(OH)_2COOH + 1\frac{1}{2}H_2O$	181.07
17	Resorcylic acid (β) COOH, $(OH)_2$ (1, 2, 4)		$C_6H_3(OH)_2COOH + 3H_2O$	208.10
18	Retene		$C_{18}H_{18}$	234.14
19	Rhamnite		$CH_3\cdot(CHOH)_4CH_2OH$	166.11
20	Rhamnose	isodulcite	$C_6H_{12}O_5 + H_2O$	182.11
21	Ricinoleïc acid		$C_{18}H_{34}O_3$	298.27
22	Rosaniline		$C(OH)\cdot(CH_3\cdot C_6H_3\cdot NH_2)\cdot(C_6H_4NH_2)_2$	319.19
23	Rosinduline		$HN{:}\,C_{10}H_5{:}\,NC_6H_4N(C_6H_5)$	321.14
24	Rosolic acid		$C_{20}H_{16}O_3$	304.13
25	Rufigallic acid		$C_{14}H_2O_2(OH)_6$	304.06
26	Rufiopin		$C_{14}H_8O_6$	272.06
27	Rufol	β-dihydroxyanthracene	$C_{14}H_{10}O_2$	210.08
28	Sabinene		$C_{10}H_{16}$	136.13
29	Saccharic acid (d.)		$C_4H_4(OH)_4(COOH)_2$	210.08
30	Saccharine	benzoylsulfimide	$C_6H_4\cdot CO\cdot NH\cdot SO_2$	183.11
31	Safrol		$C_{10}H_{10}O_2$	162.08
32	Salicin		$C_{13}H_{18}O_2(OH)_5$	286.14

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form and color	Sp. gr. $H_2O = 1$ (A)Air = 1	Melting-point °C	Boiling-point °C	Solubility in gms. per 100 c.c. of		
					Water	Alcohol	Ether
1	silky need.	.....	205 ($2H_2O$)	.....	$0.14^{25°}$	$1.16^{25°}$	sl. s.
2	red. need.	.....	194	subl.	.....	s.	s.; s. bz.; s. KOH
3	hex. pr. f. w.	.....	169	285	$5.9^{15°}$	v. s.	v. s.
4	colorl. liq.	1.090	−22.6	236.2	sl. s.	∞	∞
5	monocl. pr.	.....	231 d.	.....	$0.55^{5.5°}$	sl. s.	v. sl. s.
6	yel. pr. f. w.	1.31	115.7	subl.	sl. s.	v. s.	v. s.
7	yel. cryst.	.....	84.7–5.0	d.	sl. s. c.; s. h.	v. s. h.	v. s.
8	need. f. w.	.....	124 d.	.....	sl. s. h.	s. h.	s.
9	need	.....	.....	240 d.	.....	.....	.....
10	wh. cryst.	.....	27	229.5	s.	s.	s.
11	colorl. tricl.	.....	205–6	.....	$20.6^{20°}$	2.1 c.	.....
12	need...	1.465	118–9 anh.	.....	$14^{20°}$	v. s.	.....
13	colorl.tab.	1.272	116	276.5	v. s.	v. s.	v. s.
14	colorl. liq.	$1.080^{0°}$	.....	214–5	v. sl. s.	s.	s.
15	liq.	.....	.....	243–4	sl. s.	∞	∞
16	pr. or. need.	.....	232–3	.....	v. s. h.	v. s.	v. s.
17	need. f. eth.	.....	204–6	.....	s. h.	v. s.	s.
18	leaf.	1.13	98.5	390	.....	v. s. h.	s.
19	tricl. pr.	.....	121	.....	v. s.	v. s.	v. sl. s.
20	colorl. f. w.	1.471	126	.....	$57^{18°}$	sl. s.	insol.
21	colorl.	0.945	16–7	.....	i.	∞	∞
22	red. need. or tab.	.....	.....	.....	sl. s.	s.	s.
23	br. leaf.	.....	198–9	.....	i.	v. s.	v. s.
24	red. leaf.	.....	270	d.	v. sl. s.	v. s. h.	s.
25	or red.	.....	.....	.....	i.	s. conc. H_2SO_4	s.; s. alk.
26	yel. red.	.....	subl.	d.	sl. s. h.	s.	sl. s.; s. acet. a.
27	yel. need.	.....	d.	.....	.....	v. s.	.....
28	colorl. liq.	$0.840^{20°}$	.....	162–6	i.	∞	∞
29	.....	.....	.....	.....	v. s.	v. s.	sl. s.
30	colorl. monocl.	.....	220 d.	.....	$0.43^{25°}$	3.1	.....
31	colorl.	1.108	11	233	i.	v. s.	v. s.
32	colorl. leaf.	1.43	201	.....	3.6^{15}	s.	i.

No.	Name	Synonyms	Formula	Mol. wt.
1	Salicylamide (o.)		$HO \cdot C_6H_4 \cdot CO \cdot NH_2$	137.06
2	Salicylic acid (o.)		$HO \cdot C_6H_4 \cdot COOH$	138.05
3	acetate		$C_2H_3O_2 \cdot C_6H_4 \cdot COOH$	180.06
4	aldehyde		$HO \cdot C_6H_4 \cdot CHO$	122.05
5	anhydride		$(C_6H_4)_2O_2(CO)_2$	240.06
6	anilide		$HO \cdot C_6H_4 \cdot CO \cdot NHC_6H_5$	213.10
7	phenyl ether		$C_6H_5O \cdot C_6H_4 \cdot COOH$	214.08
8	Saligenin		$HO \cdot C_6H_4 \cdot CH_2OH$ (o.)	124.06
9	Salipyrine	antipyrene salicylate	$C_{18}H_{18}O_4N_2$	326.16
10	Salol.	See *phenyl salicytate*		
11	Santalic acid		$C_{15}H_{16}O_5$	274.11
12	Santonin		$C_{15}H_{18}O_3$	246.14
13	Sarcolactic acid	paralactic acid	$CH_3 \cdot CH(OH) \cdot COOH$	90.05
14	Sarcosine	methyl glycine	$CH_3NH \cdot CH_2 \cdot COOH$	89.06
15	Sebacic acid		$(CH_2)_8 \cdot (COOH)_2$	202.14
16	Selenium ethyl		$(C_2H_5)_2Se$	137.28
17	methyl		$(CH_3)_2Se$	109.25
18	Semicarbazide		$NH_2 \cdot CO \cdot NH \cdot NH_2$	75.06
19	hydrochloride		$NH_2 \cdot CO \cdot NH \cdot NH_2 \cdot HCl$	111.53
20	Serine		$C_2H_3(OH)(NH_2)COOH$	105.06
21	Silicoacetic acid		$CH_3 \cdot SiOOH$	76.09
22	Silicobenzoic acid		$C_6H_5 \cdot SiOOH$	138.13
23	Silicon ethyl	silicononane	$(C_2H_5)_4Si$	144.22
24	methyl		$(CH_3)_4Si$	88.16
25	phenyl chloride		$C_6H_5 \cdot SiCl_3$	211.47
26	Silver fulminate		$Ag_2C_2N_2O_2$	299.78
27	Skatole	methylindole (3)	C_9H_9N	131.08
28	Sobrerol (d. or l.)	pinol hydrate	$C_{10}H_{18}O_2$	170.14
29	Sodium acetanilide		$C_6H_5N(Na) \cdot C_2H_3O$	157.07
30	ethyl		NaC_2H_5	52.04
31	glycerate		$NaC_3H_7O_3$	114.05
32	mercaptide		C_2H_5SNa	84.10
33	Solanidine		$C_{40}H_{61}O_2N$	587.50
34	Solanine		$C_{32}H_{51}O_{11}N(?)$	625.42
35	Sorbic acid		$CH_3 \cdot CH : CH \cdot CH : CH \cdot COOH$	112.06
36	Sorbinose		$C_6H_{12}O_6$	180.10
37	Sorbite (d.)		$C_6H_{14}O_6 + \frac{1}{2}H_2O$	191.12
38	Sparteine		$C_{15}H_{26}N_2$	234.22

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form and color	Sp. gr. $H_2O = 1$ (A)Air = 1	Melting-point °C	Boiling-point °C	Solubility in gms. per 100 c.c. of		
					Water	Alcohol	Ether
1	colorl. leaf.	.....	138 (140)	270 d.	sl. s.	s. Na_2CO_3 sol.	.....
2	colorl. need.	.....	158	.....	$0.27^{20°}$	$46.85^{25°}$	$47.68^{25°}$
3	sm. w. need.	.....	132	d. >140	v. sl. s.	v. s.	v. s.
4	.....	$1.173^{13°}$	−10	196.5	sl. s.	v. s.	v. s.
5	yel. amor.	.....	200–20	d.	i.	v. s.	v. s.
6	pr.	.....	135	.....	sl. s. h.	s.	s.
7	leaf.	.....	113	355 d.	v. sl. s.	v. s.	v. s.
8	colorl. rhomb.	$1.161^{25°}$	86	subl. 100	v. s.	v. s.	v. s.
9	cryst. powd.	.....	92	.....	$0.5^{15°}$; $4.0^{100°}$	v. s. chl.	s.
10							
11	red. micr. pr.	.....	104	.....	i.	s.	s.
12	colorl. pr.	1.187	169–70	.....	0.02 c.; 0.4 h.	s.	sl. s.
13	liq.	.....	.....	d.	∞	∞	∞
14	rhomb.	.....	210 d.	.....	v. s.	sl. s.	.....
15	thin colorl. leaf.	.....	133–3.5	$295^{100mm.}$	$0.1^{17°}$ $2.0^{100°}$	v. s.	v. s.
16	liq.	$>H_2O$	.....	107–8	.....	.....	.....
17	liq.	$>H_2O$	.....	58.2	.....	.....	.....
18	pr. fr. al.	.....	96	.....	v. s.	s.	s. b.
19	pr.	.....	175 d.	.....	v. s.	i. abs.	i.
20	monocl.	.....	.....	.....	s.	i.	i.
21	.....	.....	.....	.....	i.	.....	s.
22	.....	.....	92	.....	i.	.....	s.
23	.....	0.8341°	.....	159	i.	.....	.....
24	liq.	$<H_2O$	.....	30–31	.....	.....	.....
25	liq.	.....	.....	197	d.	d.	.....
26	sm. need.	.....	exp.	.....	sl. s.	s. NH_4OH	i. HNO_3
27	leaf. f. lgr.	.....	95	265–6	0.05 c.	v. s.	.....
28	colorl.	.....	150	270–1	$3.3^{15°}$	v. s.	v. s.
29	powd.	.....	.....	.....	.....	.....	.....
30	.....	.....	.....	.....	.....	.....	.....
31	wh. powd.	.....	.....	.....	d.	s.	.....
32	wh. cryst.	.....	.....	.....	s.	s.	.....
33	need.	.....	207	subl.	sl. s.	s. h.	sl. s.
34	need.	.....	254	d.	sl. s.	s. h.	i.
35	colorl. need. f. w.	.....	134.5	228 d.	sl. s.	v. s.	v. s.
36	colorl. rhomb.	1.654	164	.....	200	v. sl. s. h.	.....
37	colorl.	.....	110–11	.....	s.	v. sl. s.	.....
38	colorl. oil.	$1.020^{10°}$	.....	abt. 328 d.	v. sl. s.	v. s.	v. s.

No.	Name	Synonyms	Formula	Mol. wt.
1	Sparteine bisulfate		$C_{15}H_{26}N_2 \cdot H_2SO_4 + 5H_2O$	422.38
2	Starch		$(C_6H_{10}O_5)x$	162.06
3	Stearic acid		$CH_3 \cdot (CH_2)_{16} \cdot COOH$	284.29
4	Stearine	tristearaine	$(C_{18}H_{35}O_2)_3C_3H_5$	890.88
5	Stearolic acid		$C_{18}H_{32}O_2$	280.26
6	Stearone		$C_{35}H_{70}O$	506.56
7	Stearoxylic acid		$C_{18}H_{32}O_4$	312.26
8	Stilbene	diphenyl ethylene	$C_6H_5 \cdot CH : CH \cdot C_6H_5$	180.10
9	Strychnine		$C_{21}H_{22}O_2N_2$	334.19
10	hydrochloride		$C_{21}H_{22}O_2N_2 \cdot HCl + 1\frac{1}{2}H_2O$	397.68
11	nitrate		$C_{21}H_{22}O_2N_2 \cdot HNO_3$	397.21
12	sulphate		$(C_{21}H_{22}O_2N_2)_2 \cdot H_2SO_4 + 5H_2O$	856.54
13	Suberic acid		$(CH_2)_6 \cdot (COOH)_2$	174.11
14	Suberone	cycloheptanone	$C_7H_{12}O$	112.10
15	Succinamide		$NH_2 \cdot CO \cdot CH_2 \cdot CH_2 \cdot CO \cdot NH_2$	116.07
16	Succinic acid		$HOOC \cdot CH_2 \cdot CH_2 \cdot COOH$	118.05
17	aldehyde		$C_2H_4(CHO)_2$	86.05
18	anhydride		$(CH_2 \cdot CO)_2O$	100.03
19	Succinimide		$C_4H_5O_2N + H_2O$	117.06
20	Succinonitrile	See *ethylene cyanide*		
21	Succinyl chloride		$ClOC \cdot CH_2 \cdot CH_2 \cdot COCl$	154.96
22	Sucrose	cane sugar	$C_{12}H_{22}O_{11}$	342.18
23	Sulphaldehyde		$(CH_3 \cdot CHS)_3$	180.29
24	Sulfamine benzoic acid (o.)		$NH_2 \cdot SO_2 \cdot C_6H_4 \cdot COOH$	201.13
25	Sulfanilic acid	aminobenzene sulfonic acid (p.)	$NH_2 \cdot C_6H_4 \cdot SO_3H$ (p.) $+ H_2O$	191.14
26	Sulfoacetic acid		$SO_3H \cdot CH_2 \cdot COOH + H_2O$	158.11
27	Sulfobenzid		$(C_6H_5)_2 \cdot SO_2$	218.14
28	Sulfobenzoic acid (o.)		$SO_3H \cdot C_6H_4 \cdot COOH + 3H_2O$	256.16
29	Sulfobenzoic acid (m.)		$SO_3H \cdot C_6H_4 \cdot COOH + 2H_2O$	238.14
30	Sulfobenzoic acid (p.)		$SO_3H \cdot C_6H_4 \cdot COOH + 3H_2O$	256.16
31	Sulfocyanic acid	thiocyanic acid	CNSH	59.08
32	Sulfonal	acetone diethyl sulfone	$(CH_3)_2C(SO_2C_2H_5)_2$	228.26
33	Sylvestrene (d.)		$C_{10}H_{16}$	136.13
34	Tannic acid	tannin	$C_{14}H_{10}O_9$	322.08

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form and color	Sp. gr. $H_2O = 1$ (A)Air = 1	Melting-point °C	Boiling-point °C	Solubility in gms. per 100 c.c. of		
					Water	Alcohol	Ether
1	rh'b'dr.	.....	136	.....	$91^{25°}$	$42^{25°}$	i.
2	wh. amor.	1.5	no m. p.	.....	i.	i.	i.
3	colorl.	$0.843^{30°}$	69.3	$291^{100mm.}$	i.	2.5 c.	v. s.
4	colorl.	$0.862^{80°}$	71–1.5	.....	i.	v. sl. s.	s.
5	colorl. pr. f. al.	.....	48	260	i.	sl. s. c.	v. s.
6	leaf.	0.7979	87.8	.....	.....	sl. s. h.	sl. s. h.
7	leaf.	.....	86	.....	i.	s.	s.
8	colorl. tab.	.....	124	306–7	i.	sl. s.	v. s.
9	tetr. f. al.	.....	abt. 268 d.	.....	$0.016^{25°}$	0.9	0.018
10	colorl. trim.	.....	.....	.....	2.9 c.	1.7	.....
11	colorl. need.	.....	dec.	.....	$2.4^{25°}$	$0.83^{25°}$	$0.64^{25°}$ chl.
12	colorl. pr.	.....	anh. 200	.....	$3.2^{25°}$	$1.5^{25°}$	i.
13	colorl. need. or tab.	.....	140	abt. 300	$0.14^{16°}$	s.	v. sl. s.
14	oil	$0.969^{0°}$	.....	180	sl. s.	v. s.	s.
15	colorl. need.	.....	242–3	.....	$0.45^{15°}$; $11^{100°}$	i.	i.
16	colorl. monocl.	1.564	187	234	$6.8^{20°}$; $121^{100°}$	sl. s.	sl. s.
17	liq.	.....	.....	201–3	s.	s.	s.
18	colorl. need. f. al.	$1.104^{20°}$	119.6	.....	i.	s.	v. sl. s.
19	octah'dr.	.....	124	287–8	v s.	s.	v. sl. s.
20							
21	colorl.	1.412	16–7	190–2	.....	.....	.....
22	colorl. monocl.	$1.588^{18°}$	abt. 160–70 d.	.....	200 c.	sl. s.	.....
23	.....	.....	45–6	subl.	i.	s.	s.
24	rh'b'dr.	.....	165–7 (155)	.....	v. s.	v. s.	v. s.
25	rhomb. pl.	.....	d. 280	.....	$0.89^{15°}$	v. sl. s.	v. sl. s.
26	tab. f. w.	.....	84–6	.....	s.	v. s.	i.
27	tab.	.....	123–4	.....	i.	sl. s.	sl. s.
28	trim.	.....	anh.250*	.....	50.	v, s.	i.
29	.....	.....	anh. 141	.....	.....	.....	v. s.
30	need.	.....	259–50	.....	v. s.	v. s.	v. s.
31	liq.	.....	5	.....	∞	v. s.	v. s.
32	prisms	.....	126	300 d.	$2^{15°}$; $6.7^{100°}$	50 h. abs.	sl. s.
33	.....	$0.8510^{16°}$	.....	176–7	.....	.....	.....
34	amor. powd.	.....	abt. 200	.....	20	167	v. sl. s.

* The anhydride melts at 118° C.

No.	Name	Synonyms	Formula	Mol. wt.
1	Tartaric acid (i.)	mesotartaric acid.	$HOOC(CHOH)_2 \cdot COOH + H_2O$	168.06
2	" " (d. or l.)	.....	$HOOC(CHOH)_2 \cdot COOH$	150.05
3	Tartronic acid	.....	$CH(OH) \cdot (COOH)_2 + \frac{1}{2}H_2O$	129.04
4	Taurine	.....	$NH_2 \cdot CH_2 \cdot CH_2 \cdot SO_3H$	125.13
5	Taurocholic acid	.....	$C_{26}H_{45}NO_7S + H_2O$	533.45
6	Tellurium ethyl	.....	$(C_2H_5)_2Te$	185.58
7	methyl	.....	$(CH_3)_2Te$	157.55
8	Teraconic acid	.....	$(CH_3)_2C : C(COOH)CH_2COOH$	158.08
9	Terebene	.....	$C_{10}H_{16}$	136.13
10	Terebic acid	.....	$C_7H_{10}O_4$	158.08
11	Terephthalic acid	.....	$C_6H_4 \cdot (COOH)_2$ (p.)	166.05
12	aldehyde	.....	$C_6H_4 \cdot (CHO)_2$ (p.)	134.05
13	nitrile	.....	$C_6H_4 \cdot (CN)_2$ (p.)	128.05
14	Terpenol	.....	$C_{10}H_{18}O$	154.14
15	Terpinene	.....	$C_{10}H_{16}$	136.13
16	Terpineol	.....	$C_{10}H_{18}O$	154.14
17	Terpine hydrate	.....	$C_{10}H_{20}O_2 + H_2O$	190.18
18	Terpinolene	.....	$C_{10}H_{16}$	136.13
19	Tetrabromo-benzene (sym.) (1, 2, 4, 5)	.....	$C_6H_2Br_4$	393.68
20	Tetrabromo-benzene (uns.) (1, 3, 4, 5)	.....	$C_6H_2Br_4$	393.68
21	Tetrabromo-benzene	.....	$C_6H_2Br_4$	393.68
22	Tetrabromo-benzene	.....	$C_6H_2Br_4$	393.68
23	Tetrabrom-ethane (sym.)	.....	$CHBr_2 \cdot CHBr_2$	345.68
24	fluorescein.	See *eosine*		
25	Tetrachlor-acetone (sym.)	.....	$CHCl_2 \cdot CO \cdot CHCl_2 + 2H_2O$	231.88
26	aniline	.....	$NH_2 \cdot C_6HCl_4$ (1, 2, 3, 4, 5)	230.87
27	"	.....	$NH_2 \cdot C_6HCl_4$ (2, 3, 5, 6)	230.87
28	benzene	.....	$C_6H_2Cl_4$ (1, 2, 3, 4)	215.84
29	"	.....	$C_6H_2Cl_4$ (1, 2, 3, 5)	215.84
30	"	.....	$C_6H_2Cl_4$ (1, 2, 4, 5)	215.84
31	ethane.	See *acetylene tetrachloride*		
32	" (uns.)	.....	$CH_2Cl \cdot CCl_3$	167.84
33	ethylene	.....	$CCl_2 : CCl_2$	165.83
34	hydroquinone	.....	$C_6Cl_4(OH)_2$	247.84
35	Tetradecane (n.)	.....	$C_{14}H_{30}$	198.24
36	Tetradecylene	.....	$C_{14}H_{28}$	196.22
37	Tetraethyl-ammonium hydroxide	.....	$(C_2H_5)_4NOH$	147.18

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form and color	Sp. gr. $H_2O = 1$ (A)Air = 1	Melting-point °C	Boiling-point °C	Solubility in gms. per 100 c.c. of		
					Water	Alcohol	Ether
1	tab.	1.666	140–3 anh.	.....	125 c	.....	.....
2	colorl. monocl.	1.76	168–70	.....	$139^{20°}$	v. s.	v. sl. s.
3	colorl. pr. f. eth.	.....	185–7 d.	.....	v. s.	v. s.	sl. s.
4	tetr. need.	.....	88	d.	$6.5^{12°}$	i.	i.
5	deliq. need.	.....	.....	.....	v. s.	v. s.	sl. s.
6	liq.	.....	.....	<100	.....	.....	.....
7	liq.	.....	.....	82	i.	.....	.....
8	tricl.	.....	164 d.	to. anh.	v. s.	v. s.	v. s.
9	liq.	$0.876^{0°}$	.....	156	.....	.....	.....
10	monocl.	$0.815^{24°}_{24°}$	174	d.	sl. s.	s.	s.
11	powd.	.....	subl.	.....	v. v. sl. s.	v. sl. s.	v. sl. s.
12	need. f. w.	.....	116	245–8	$1.5^{100°}$	v. s.	v. sl. s.
13	colorl.	.....	215 (222)	.....	i.	sl. s.	sl. s.
14	pr.	.....	69–70	.....	.....	.....	.....
15	colorl. liq.	$0.865^{20°}$	.....	179–82	i.	∞	∞
16	colorl.	$0.936^{20°}$	25	218	i.	v. s.	v. s.
17	colorl. rhomb.	.....	116–7	.....	$0.5^{25°}$	10	v. s.
18	colorl. liq.	.....	.....	183–5	i.	∞	∞
19	pr.	$3.027^{20°}$	174–5	.....	.....	.....	.....
20	need.	.....	98.5	329	.....	v. sl. s.	v. s.
21	sm. need. f. al.	.....	160	.....	.....	.....	.....
22	.....	.....	136–8	.....	.....	.....	.....
23	.....	2.972	<–20	.....	i.	∞	∞
24							
25	.....	.....	48	.....	.....	.....	.....
3	.....	.....	118	.....	v. s. bz.	v. s.	v. s.
27	.....	.....	90	.....	.....	.....	.....
28	need.	.....	45–6	254	.....	sl. s.	v. s.
29	need.	.....	50–1	246	i.	v. sl. s.	.....
30	monocl.	1.858²¹°	140–1	243–6	.....	sl. s. h.	s.
31							
32	.....	1.6116°°	.....	135	.....	.....	.....
33	colorl. liq.	$1.608^{25°}$	–19	119	i.	∞	∞
34	monocl. f. bz.	.....	232	subl.	i.	v. s.	v. s.; s. bz
35	colorl. liq.	$0.765^{20°}$	5.5	252.5	i.	v. s.	v s.
36	liq.	$0.785^{?°}$	.....	$127^{15mm.}$	.....	.....	.....
37	need.	.....	d. 190	.....	.....	f.	.....

PHYSICAL CONSTANTS OF

No.	Name	Synonyms	Formula	Mol. wt.
1	Tetraethylbenzene (sym.)	.....	$C_6H_2\cdot(C_2H_5)_4$ (1, 2, 4, 5)	190.18
2	urea.....	.....	$(C_2H_5)_2N\cdot CO\cdot N(C_2H_5)_2$	244.18
3	Tetrahydrobenzene	.....	C_6H_{10}.....	82.08
4	Δ'-Tetrahydrobenzoic acid	.....	$CH_2\cdot(CH_2)_3\cdot CH:C\cdot COOH$	126.08
5	Tetrahydronaphthalene	.....	$C_{10}H_{12}$.....	132.10
6	Tetrahydronaphthol (α)	.....	$HO\cdot C_6H_3CH_2(CH_2)_2CH_2$	148.10
7	Tetrahydronaphthylamine	.....	$C_{10}H_{11}\cdot NH_2$(α, ar.)	147.11
8	Tetrahydronaphthylamine	.....	$C_{10}H_{11}\cdot NH_2$(β, ac.)	147.11
9	Δ'-Tetrahydrophthalic acid	.....	$C_8H_{10}O_4$.....	170.08
10	Tetrahydroquinoline	.....	$C_9H_{11}N$.....	133.10
11	Tetrahydroquinone	.....	$C_6H_4O_2H_4$.....	112.06
12	Tetrahydroxybenzene (sym.)	.....	$C_6H_2(OH)_4$ (1, 2, 4, 5)	142.05
13	Tetrahydroxybenzoic acid	.....	$(HO)_4C_6H\cdot COOH$..	186.05
14	Tetrahydroxyquinone	.....	$(HO)_4C_6O_2$.....	172.03
15	Tetraiodoethylene	.....	$CI_2:CI_2$.....	531.73
16	Tetraiodopyrrol..	iodol.....	C_4I_4NH.....	570.74
17	Tetramethylammonium hydroxide	.....	$(CH_3)_4\cdot NOH + 5H_2O$	181.19
18	benzene (1, 2, 3, 4)	.....	$C_6H_2\cdot(CH_3)_4$.....	134.11
19	" (1, 2, 3, 5)	See *isodurene*		
20	" (1, 2, 4, 5)	durene.....	$C_6H_2\cdot(CH_3)_4$.....	134.11
21	diaminobenzhydrol	.....	$HO\cdot CH[C_6H_4N(CH_3)_2]_2$	270.19
22	diaminobenzophenone	Michler's ketone	$(CH_3)_2N\cdot C_6H_4\cdot CO\cdot C_6H_4\cdot N(CH_3)_2$	268.18
23	diaminodiphenylamine	.....	$NH[C_6H_4N(CH_3)_2]_2$	255.19
24	diaminotriphenylmethane	.....	$C_6H_5CH[C_6H_4N(CH_3)_2]_2$	330.22
25	leuco-aniline....	.....	$[(CH_3)_2\cdot N\cdot C_6H_4]_2\cdot CH\cdot C_6H_4\cdot NH_2$	345.24
26	succinic acid...	.....	$C_2(CH_3)_4(COOH)_2$..	174.11
27	urea.....	.....	$(CH_3)_2N\cdot CO\cdot N(CH_3)_2$	116.11
28	Tetramethylenediamine	putrescine.....	$NH_2\cdot(CH_2)_4\cdot NH_2$...	88.11

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form and color	Sp. gr. $H_2O = 1$ (A)Air = 1	Melting-point °C	Boiling-point °C	Solubility in gms. per 100 c.c. of		
					Water	Alcohol	Ether
1	colorl. liq.	0.888	13	250	i.	v. s.	v. s.
2	liq.	.....	.....	210–5	s. a.	.....	.....
3	colorl. liq.	.....	.....	82–4	.....	.....	.....
4	.....	$1.109^{20°}$	29	243	sl. s.	.....	.....
5	colorl. liq.	$0.981^{13°}$	.....	205	i.	v. s.	v. s.
6	monocl. wh. pl.	.....	69	$265^{705mm.}$	sl. s. h.	v. s.	v. s.
7	oil	.....	.....	277	s. dil. a.	.....	.....
8	liq.	$1.034^{15°}_{15°}$	.....	251–2	.....	.....	.....
9	leaf.	.....	.....	.....	.....	.....	.....
10	colorl.-br.	$1.063^{15°}_{15°}$	abt. 20	251	v. sl. s.	∞	∞
11	wh. pr.	.....	78	.....	.....	.....	.....
12	leaf.	.....	215–20	.....	s.	s.	v. s.
13	.....	.....	148	.....	.....	.....	.....
14	cryst.	.....	.....	.....	s. h.	v. s.	sl. s.
15	monocl. pr.	$2.983^{20°}$	192	subl.	v. s. CS_2	.....	s.
16	yel. need.	.....	d. 140–50		0.02	$5.8^{15°}$ 90%	50; s. bz.
17	.....	.....	62–3	dec.	∞ 63°	v. s.	.....
18	colorl.	$0.882^{9°}$	–4	204	.....	.....	.....
19							
20	monocl. leaf.	$0.838^{81°}$	79	abt. 190	v. s. bz.	v. s.	v. s.
21	pr.	.....	96	.....	.....	s.	s.
22	glit. leaf.	.....	171.5 (174)	d. 360	.....	v. s.	v. s.
23	tetr. pl. f. CS_2	.....	119	.....	.....	s.	.....
24	tricl. need. (leaf.)	.....	93 (102)	.....	i.	s.	s.
25	glit. cryst.	.....	151–2	.....	.....	v. sl. s.	.....
26	.....	.....	95	subl.	1:45	s.	s.
27	liq.	0.972	.....	177	.....	v. s.	v. s.
28	leaf.	.....	27–8	159	v. s.	.....	.....

No.	Name	Synonyms	Formula	Mol. wt.
1	Tetranitro-diphenol	.....	$[C_6H_2(NO_2)_2OH]_2$...	366.08
2	diphenyl.....	.....	$C_{12}H_6(NO_2)_4$.....	334.08
3	diphenyl methane	.....	$C_{13}H_8 \cdot (NO_2)_4$.....	348.10
4	methane.....	.....	$C(NO_2)_4$	196.03
5	naphthalene (α)	.....	$C_{10}H_4 \cdot (NO_2)_4$.....	308.06
6	" (1, 3, 6, 8)	.....	$C_{10}H_4 \cdot (NO_2)_4$.....	308.06
7	" (1, 3, 5, 8)	.....	$C_{10}H_4 \cdot (NO_2)_4$.....	308.06
8	phenol.....	.....	$HO \cdot C_6H \cdot (NO_2)_4$ (1, 2, 3, 4, 6)	274.05
9	Tetraphenyl-ethane (sym.)	.....	$(C_6H_5)_2CH \cdot CH (C_6H_5)_2$	334.18
10	ethylene.....	.....	$(C_6H_5)_2C : C(C_6H_5)_2$	332.16
11	urea.....	.....	$(C_6H_5)_2N \cdot CO \cdot N(C_6H_5)_2$	364.18
12	Tetrazole.....	.....	$CH : N \cdot NH \cdot N : N$	70.05
13	Tetrolic acid.....	.....	$CH_3 \cdot C : C \cdot COOH$..	84.03
14	Tetronal.....	.....	$C_9H_{20}O_4S_2$.....	256.29
15	Thallin.....	p-methoxytetra-hydroquinoline	$C_9H_{10}ON \cdot CH_3$.....	163.10
16	Thebaine.....	paramorphine....	$C_{19}H_{21}O_3N$.....	311.18
17	hydrochloride...	.....	$C_{19}H_{21}O_3N \cdot HCl + H_2O$	365.63
18	Theïne.	See *caffeïne*		
19	Theobromine.....	dimethylxanthine	$C_7H_8O_2N_4$.....	180.10
20	Theophylline.....	.....	$C_7H_8O_2N_4 + H_2O$...	198.11
21	Thialdine.....	.....	$C_6H_{13}NS_2$.....	163.24
22	Thianthrene.....	.....	$(C_6H_4)_2S_2$	216.19
23	Thiazole.....	.....	C_3H_3NS.....	85.10
24	Thio-acetamide.	.....	$CH_3 \cdot CS \cdot NH_2$.....	75.11
25	acetanilide.....	.....	$C_6H_5 \cdot NH \cdot CS \cdot CH_3$	151.14
26	acetic acid.....	.....	$CH_3 \cdot COSH$.....	76.10
27	aniline.....	.....	$(C_6H_4 \cdot NH_2)_2S$.....	216.18
28	benzaldehyde (α)	.....	$C_6H_5 \cdot CHS$.....	122.11
29	" (β)	.....	$C_6H_5 \cdot CHS$.....	122.11
30	benzoic acid....	.....	$C_6H_5 \cdot COSH$.....	138.11
31	carbonyl chloride	See *thiophosgene*		
32	cresol (o.).....	.....	$C_6H_4 \cdot CH_3 \cdot SH$.....	124.13
33	" (m.).....	.....	$C_6H_4 \cdot CH_3 \cdot SH$.....	124.13
34	" (p.).....	.....	$C_6H_4 \cdot CH_3 \cdot SH$.....	124.13
35	cyanic acid. See	*sulfocyanic acid*		
36	cyanuric acid...	.....	$C_3H_3N_3S_3$.....	177.24
37	diphenylamine..	.....	$S \cdot (C_6H_4)_2 \cdot NH$.....	199.14
38	hydroquinone...	.....	$C_6H_4(SH)_2$.....	142.18
39	naphthene.....	benzothiophene...	C_8H_6S.....	134.11

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form and color	Sp. gr. $H_2O = 1$ (A) Air = 1	Melting-point °C	Boiling point °C	Solubility in gms. per 100 c.c. of		
					Water	Alcohol	Ether
1	yel. need.	.....	225	.....	i	s.	.....
2	.....	.....	140	.....	i.	sl. s.	sl. s.
3	yel. pr. f. glac. acet. a.	.....	172	.....	.....	i.	i.
4	.....	1.650	13	126	i.	s.	s.
5	rhomb. f. chl.	.....	259	exp.	v. sl. s.	v. sl. s.	v. sl. s.
6	long need. f. al.	.....	203	exp.	i.	.....	.....
7	yel. tetr. f. acet.	.....	194–5	.....	v. s. acet.	sl. s.	sl. s. chl.
8	yel. need.	.....	130	exp.!	v. s.	v. sl. s. bz.	v. sl. s. lgr.
9	colorl. need. f. chl.	1.182	209	279–83	s. acet. a.	sl. s. h.	14 bz.
10	colorl. monocl.	.....	221	415–25	i.	v. sl. s.	v. s. bz.
11	colorl.	.....	183	.....	i.	.....	.....
12	leaf.	.....	156	subl.	s.	s.	i.
13	colorl. tab.	.....	76	203	v. s.	v. s.	v. s.
14	glit. leaf.	.....	85	.....	0.22 c.	v. s.	v. s.
15	rhombic.	.....	42–3	283	s. h.	v. s.	v. s.
16	glit. pr. f. al.	.....	193	.....	v. sl. s.	10 c.; v. s. bz.	0.71^{100}; v. s. chl.
17	rhomb.	.....	.....	.....	.....	6.3^{100}	.....
18							
19	rhomb. f. w.	.....	337	subl.	$0.03^{18°}$; $0.67^{100°}$	$0.023^{17°}$	0.95. h. chl.
20	need. f. w.	.....	264	.....	$0.44^{15°}$; $1.3^{37°}$	sl. s.	sl. s.
21	monocl.	1.191	43	d.	sl. s.	s.	v. s.
22	.....	.....	158	360	.....	.....	.....
23	colorl. liq.	$1.200^{17°}$	.....	117	.....	.....	.....
24	monocl. tab. f. eth.	.....	108	.....	v. s.	s.	s.
25	need.	.....	75	dec.	i.	s. alk.	.....
26	colorl. liq.	$1.074^{100°}$	.....	93	∞	∞	∞
27	need. f. w.	.....	105	.....	v. sl. s.	s.	s,
28	wh.	.....	160	d.	i.	i.	s. bz.
29	need.	.....	225	.....	.....	sl. s.	s. acet. a.
30	.....	.....	24	.....	i.	∞	∞
31							
32	leaf.	.....	15	194	i.	s.	.....
33	.....	1.06252°	<−20	195.5	.....	.....	.....
34	leaf. f. eth.	.....	43	190–1	i.	s.	v. s.
35							
36	yel. need.	.....	d. 200	.....	v. s. h.	v. sl. s.	v. sl. s.
37	rhomb.	.....	180	371 d.	v. s. bz.	sl. s.	s.
38	leaf.	.....	98	.....	.....	.....	.....
39	leaf.	.....	31	221	.....	.....	.....

No.	Name	Synonyms	Formula	Mol. wt.
1	Thio-phenol	phenyl mercaptan	$C_6H_5 \cdot SH$	110.11
2	phosgene	thiocarbonyl chloride	$CSCl_2$	114.98
3	resorcinol (1, 3)		$C_6H_4(SH)_2$	142.18
4	semicarbazide		$NH_2 \cdot CS \cdot NH \cdot NH_2$	91.13
5	tolene		$C_4H_3 \cdot CH_2 \cdot S$	98.11
6	urea		$NH_2 \cdot CS \cdot NH_2$	76.11
7	urethane		$NH_2 \cdot CO \cdot SC_2H_5$	105.13
8	Thionin	Lauth's violet	$C_{12}H_9N_3S$	227.16
9	Thiophene		C_4H_4S	84.10
10	alcohol		$C_4H_3S \cdot CH_2OH$	114.11
11	aldehyde		$C_4H_3S \cdot CHO$	112.10
12	carboxylic acid (α) (1, 2)		$C_4H_3S \cdot COOH$	128.10
13	carboxylic acid (β) (1, 3)		$C_4H_3S \cdot COOH$	128.10
14	Thujone	tanacetone	$C_{10}H_{16}O$	152.13
15	Thymene		$C_{10}H_{16}$	136.13
16	Thymohydroquinone		$C_{10}H_{14}O_2$	166.11
17	Thymol	methyl-isopropyl phenol (3, 6)	$CH_3 \cdot C_6H_3(OH) \cdot C_3H_7$	150.11
18	Thymoquinone		$(CH_3)_2CH \cdot C_6H_2(CH_3)O_2$	164.10
19	Thymotic acid		$C_6H_2(CH_3)(C_3H_7)COOH \cdot OH$	194.11
20	Tiglic acid		$CH_3 \cdot CH : C(CH_3) \cdot COOH$	100.06
21	Tin diethyl		$Sn(C_2H_5)_2$	176.78
22	tetraethyl		$Sn(C_2H_5)_4$	234.86
23	tetramethyl		$Sn(CH_3)_4$	178.80
24	triethyl		$Sn_2(C_2H_5)_6$	411.64
25	Tolane	diphenyl acetylene	$C_6H_5 \cdot C : C \cdot C_6H_5$	178.08
26	Tolidine (o.)	4, 4′-diamino-3, 3′-dimethyl-diphenyl	$(NH_2)CH_3 : C_6H_3 \cdot C_6H_3 : CH_3(NH_2)$	212.14
27	" (m.)		$(CH_3 \cdot C_6H_3 \cdot NH_2)_2$	212.14
28	" (p.)		$(CH_3 \cdot C_6H_3 \cdot NH_2)_2$	212.14
29	Toluamide (o.)		$CH_3 \cdot C_6H_4 \cdot CO \cdot NH_2$	135.08
30	" (m.)		$CH_3 \cdot C_6H_4 \cdot CO \cdot NH_2$	135.08
31	" (p.)		$CH_3 \cdot C_6H_4 \cdot CO \cdot NH_2$	135.08
32	Toluene		$C_6H_5 \cdot CH_3$	92.06
33	sulfonic acid (o.)		$CH_3 \cdot C_6H_4 \cdot SO_3H + 2H_2O$	208.16
34	" " (m.)		$CH_3 \cdot C_6H_4 \cdot SO_3H + H_2O$	190.14
35	" " (p.)		$CH_3 \cdot C_6H_4 \cdot SO_3H + 4H_2O$	244.19
36	" amide (o.)		$CH_3 \cdot C_6H_4 \cdot SO_2 \cdot NH_2$	171.14
37	Toluic acid (o.)		$CH_3 \cdot C_6H_4 \cdot COOH$	136.06
38	" " (m.)		$CH_3 \cdot C_6H_4 \cdot COOH$	136.06

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form and color	Sp. gr. $H_2O = 1$ (A)Air = 1	Melting-point °C	Boiling-point °C	Solubility in gms. per 100 c.c. of		
					Water	Alcohol	Ether
1	liq.	1.078	.....	168	i.	v. s.	∞
2	red. liq.	1.508	.....	73	i.	s.	s.
3	cryst.	.....	27	243; 116.4$^{11mm.}$	.....	.....	.....
4	need. f. w.	.....	181–3	.....	s.	.....	.....
5	.....	1.0194	18	113	.....	.....	.....
6	pr.	.....	180	.....	9	v. sl. s.	v. sl. s.
7	leaf. pl.	.....	102	subl.	s. h.	s.	s.
8	br. leaf.	.....	.....	.....	v. sl. s.	sl. s.	.....
9	liq.	1.071	.....	84	i.	s.	s. H_2SO_4
10	.....	.....	.....	207	.....	.....	.....
11	oil	1.215$^{21°}$	.....	198	.....	.....	s.
12	need. f. w.	.....	126.5	260	v. s. h.	v. s.	v. s.
13	need. f. w.	.....	136	.....	.....	.....	.....
14	colorl. liq.	0.913$^{20°}$	.....	203	.....	.....	.....
15	liq.	.....	.....	165	.....	.....	.....
16	.....	.....	139.5	subl.	s. h	.....	.....
17	colorl. pl.	0.979$^{15°}_{15°}$	49.6	228–32	0.083$^{15°}$ 0.11$^{100°}$	v. s.	v. s.
18	yel. pr. tab.	.....	45.5	200	v. sl. s.	v. s.	v. s.
19	cryst.	.....	120	subl.	sl. s. h.	s.	s.
20	colorl. pr.	0.964$^{76°}$	64.5	198.5	sl. s. c.; v. s. h.	s.	s.
21	oil	.....	.....	dec.	i.	s.	.....
22	colorl. liq.	1.187$^{28°}$	.....	181	i.	s.	.....
23	colorl. liq.	1.314$^{0°}$	.....	78	i.	.....	s.
24	liq.	1.4115$^{0°}$	.....	270 d.	.....	i.	.....
25	colorl. leaf.	.....	60	275–300	.....	s.	v. s.
26	colorl. sc. f. h. w.	.....	129–30	.....	sl. s.	v. s.	v. s.
27	cryst.	.....	108–9	.....	.....	.....	.....
28	leaf.	.....	103	.....	s. h.	v. s.	v. s.
29	colorl. need.	.....	abt. 139	.....	sl. s. c.; v. s. h.	v. s.	v. s.
30	.....	.....	94 (97)	.....	sl. s.	.....	.....
31	colorl. need. f. w.	.....	158–9 (165)	.....	sl. s. c.; v. s. h.	v. s.	sl. s.
32	colorl. liq.	0.866$^{20°}$	.....	111	i.	∞	∞
33	cryst.	.....	.....	129$^{25mm.}$	v. s.	s.	.....
34	need.	.....	.....	.....	v. s.	s.	.....
35	leaf. or pr.	.....	92	.....	v. s.	s.	.....
36	octahd'r.	.....	155	.....	0.1$^{9°}$	3.6$^{5°}$	.....
37	colorl. need.	.....	102 (104)	259	s. h.	v. s.	s. chl.
38	colorl. pr. f. w.	.....	110.5	263	1.67$^{100°}$	v. s.	v. s.

No.	Name	Synonyms	Formula	Mol. wt.
1	Toluic acid (p.)...	.....	$CH_3 \cdot C_6H_4 \cdot COOH$..	136.06
2	" anhydride (o.)	.....	$(CH_3 \cdot C_6H_4 \cdot CO)_2O$	254.11
3	Toluidine (o.)....	amino-toulene (o.)	$CH_3 \cdot C_6H_4 \cdot NH_2$....	107.08
4	" (m.)...	" " (m.)	$CH_3 \cdot C_6H_4 \cdot NH_2$....	107.08
5	" (p.)....	" " (p.)	$CH_3 \cdot C_6H_4 \cdot NH_2$....	107.08
6	Tolunitrile (o.)...	.....	$CH_3 \cdot C_6H_4 \cdot CN$.....	117.06
7	" (m.)..	.....	$CH_3 \cdot C_6H_4 \cdot CN$.....	117.06
8	" (p.)...	.....	$CH_3 \cdot C_6H_4 \cdot CN$.....	117.06
9	Toluquinone CH_3, O, O (1, 2, 5)	.....	$CH_3 \cdot C_6H_3O_2$.....	122.05
10	Toluylene diamine (2, 4)	diamino-toluene..	$CH_3 \cdot C_6H_3 \cdot (NH_2)_2$..	122.10
11	Toluylene diamine (3, 4)	" " ..	$CH_3 \cdot C_6H_3 \cdot (NH_2)_2$..	122.10
12	Tolyl acetic acid (o.)..	.....	$CH_3 \cdot C_6H_4 \cdot CH_2 \cdot COOH$	150.08
13	" " (p.)..	.....	$CH_3 \cdot C_6H_4 \cdot CH_2 \cdot COOH$	150.08
14	carbinol (o.)....	.....	$CH_3 \cdot C_6H_4 \cdot CH_2OH$	122.08
15	" (m.)...	.....	$CH_3 \cdot C_6H_4 \cdot CH_2OH$	122.08
16	" (p.)....	.....	$CH_3 \cdot C_6H_4 \cdot CH_2OH$	122.08
17	chloride (o.)....	.....	$CH_3 \cdot C_6H_4 \cdot CH_2Cl$..	140.53
18	" (m.)...	.....	$CH_3 \cdot C_6H_4 \cdot CH_2Cl$..	140.53
19	" (p.)....	.....	$CH_3 \cdot C_6H_4 \cdot CH_2Cl$..	140.53
20	diphenylmethane (p.)	.....	$(C_6H_5)_2CH \cdot C_6H_4(CH_3)$	258.14
21	" (m.)	.....	$(C_6H_5)_2CH \cdot C_6H_4(CH_3)$	258.14
22	hydrazine (o.)...	.....	$CH_3 \cdot C_6H_4 \cdot NH \cdot NH_2$	122.10
23	" (m.)..	.....	$CH_3 \cdot C_6H_4 \cdot NH \cdot NH_2$	122.10
24	" (p.)..	.....	$CH_3 \cdot C_6H_4 \cdot NH \cdot NH_2$	122.10
25	hydroxylamine..	.....	$CH_3 \cdot C_6H_4 \cdot NH(OH)$	123.08
26	mustard oil (o.)	.....	$CH_3 \cdot C_6H_4 \cdot NCS$....	149.13
27	" " (p.)	.....	$CH_3 \cdot C_6H_4 \cdot NCS$....	149.13
28	phenyl ketone.	See *phenyl tolyl ketone*		
29	Tolylene-alcohol (o.)	.....	$C_6H_4(CH_2OH)_2$.....	138.08
30	" " (m.)	.....	$C_6H_4(CH_2OH)_2$.....	138.08
31	" " (p.)	.....	$C_6H_4(CH_2OH)_2$.....	138.08
32	chloride (o.)....	.....	$C_6H_4(CH_2Cl)_2$.....	174.98
33	" (m.)...	.....	$C_6H_4(CH_2Cl)_2$.....	174.98
34	" (p.)....	.....	$C_6H_4(CH_2Cl)_2$.....	174.98
35	cyanide (o.)....	.....	$C_6H_4(CH_2CN)_2$.....	156.08
36	" (m.)....	.....	$C_6H_4(CH_2CN)_2$.....	156.08
37	" (p.)....	.....	$C_6H_4(CH_2CN)_2$.....	156.08
38	Triacetamide....	.....	$(CH_3CO)_3N$.....	143.08

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form and color	Sp. gr. H_2O = 1 (A) Air = 1	Melting-point °C	Boiling-point °C	Solubility in gms. per 100 c.c. of		
					Water	Alcohol	Ether
1	colorl. need.	.....	176–7	275	s. h.	v. s.	v. s.
2	colorl. f. eth.	.....	36–7	abt. 325	.....	.....	.....
3	liq.	$1.003^{15°}$	.....	199.5	sl. s.	∞	∞
4	liq.	$0.989^{20°}$	.....	203	sl. s.	∞	∞
5	leaf.	.....	42.9 (45)	200.5	$0.74^{21°}$	.....	.....
6	liq.	0.998	.....	205.2	i.	∞	∞
7	liq.	.....	.....	208–10	0.085 c.; 1.67 h.	.....	.....
8	.....	.....	38 (29.5)	217.3	i.	v. s.	v. s.
9	yel. leaf.	.....	67	subl.	s. h.	v. s.	v. s.
10	colorl. need. f. lgr.	.....	99	280	s.	v. s.	v. s.
11	colorl. sc.	.....	88.5	265	s.	.....	.....
12	colorl. need.	.....	88–9	.....	v. s. h.	.....	.....
13	colorl. need.	.....	91	266	sl. s. c.; v. s. h.	.....	.....
14	colorl. need.	$1.023^{40°}$	34	223	1 c.	v. s.	v. s.
15	colorl. liq.	$1.036^{0°}$	<–20	217	5 c.	.....	s.
16	colorl. need.	.....	59	217	sl. s. c.	v. s.	v. s.
17	colorl. liq.	.....	.....	197–9	i.	v. s.	v. s.
18	.....	.....	.....	195–6	i.	v. s.	v. s.
19	.....	.....	.....	200	i.	v. s.	v. s.
20	pr.	.....	71	>360	i.	s. h.	s.
21	.....	.....	59.5	.....	.....	sl. s.	s.
22	colorl. tab. f. lgr.	.....	56	.....	v. s. chl.	v. s.	v. s.
23	liq.	.....	.....	240–4	.....	.....	.....
24	colorl. leaf.	.....	65–6 (61)	240–4 d.	v. s. bz.	v. s.	v. s.
25	colorl. leaf. f. bz.	.....	94	.....	1 c.; 50 h.	v. s.	v. s.
26	.....	.....	.....	238–9	i.	v. s.	∞
27	.....	.....	26–7	242.4	i.	v. s.	v. s.
28							
29	pl. f. eth.	.....	64	.....	s.	s.	s.
30	cryst.	$1.161^{18°}$	46–7	.....	v. s.	.....	s.
31	need.	.....	112–3	.....	v. s.	v. s.	v. s.
32	f. lgr.	$1.393^{0°}$	54	239–41	.....	v. s.	v. s. lgr.
33	.....	$1.302^{20°}$	34.2	250–5	.....	.....	.....
34	pl. or leaf.	$1.417^{0°}$	100	240–50	.....	.....	.....
35	cryst.	.....	59–60	.....	.....	s.	s.
36	cryst.	.....	28–9	305–10 ^{300mm}	.....	s.	s. chl.
37	lng. pr. f. eth.	.....	98	.....	sl. s. h.	s. h.	s. chl.
38	sm. need.	.....	78–9	.....	.....	.....	s.

PHYSICAL CONSTANTS OF

No.	Name	Synonyms	Formula	Mol. wt.
1	Triacetin	glyceryl triacetate	$(CH_3COO)_3C_3H_5$	218.11
2	Triacetonamine		$C_9H_{17}NO + H_2O$	173.16
3	Triamino-azobenzene	Bismarck brown	$NH_2 \cdot C_6H_4 \cdot N_2 \cdot C_6H_3 \cdot (NH_2)_2$ (3, 2′, 4′)	227.14
4	Triaminobenzene (1, 2, 3)		$C_6H_3(NH_2)_3$	123.10
5	" (1, 2, 4)		$C_6H_2(NH_2)_3$	123.10
6	Triaminobenzoic acid COOH, $(NH_2)_3$ (1, 3, 4, 5)		$(NH_2)_3C_6H_2COOH + \frac{1}{2}H_2O$	176.10
7	" (1, 2, 3, 5)		$(NH_2)_3C_6H_2COOH$	167.10
8	Triaminophenol (2, 4, 6)		$C_6H_2OH(NH_2)_3$	139.10
9	Triamylamine		$(C_5H_{11})_3N$	227.27
10	Triazole (sym.)	pyrrodiazole	CH : N · NH · CH : N	69.05
11	Tribenzoylmethane		$CH(COC_6H_5)_3$	328.13
12	Tribenzylamine		$(C_6H_5 \cdot CH_2)_3N$	287.18
13	Tribrom-acetic acid		$CBr_3 \cdot COOH$	296.76
14	aniline (2, 4, 6, 1)		$Br_3 \cdot C_6H_2 \cdot NH_2$	329.79
15	benzene (sym.) (1, 3, 5)		$C_6H_3 \cdot Br_3$	314.77
16	" (v.) (1, 2, 3)		$C_6H_3 \cdot Br_3$	314.77
17	" (uns.) (1, 3, 4)		$C_6H_3 \cdot Br_3$	314.77
18	hydrine	glyceryl tribrom-hydrine	$CH_2Br \cdot CHBr \cdot CH_2Br$	280.79
19	phenol (sym.) (2, 4, 6)		$HO \cdot C_6H_2Br_3$	330.77
20	resorcinol		$(HO)_2 \cdot C_6H \cdot Br_3$ (2, 4, 6)	346.77
21	Tributyl amine		$(C_4H_9)_3N$	185.22
22	Tributyrine	See *butyrene*		
23	Tricarballylic acid		$(CH_2 \cdot COOH)_2 \cdot CH \cdot COOH$	176.06
24	Trichlor-acetal		$CCl_3 \cdot CH(OC_2H_5)_2$	221.46
25	acetamide		$CCl_3 \cdot CO \cdot NH_2$	162.40
26	acetic acid		$CCl_3 \cdot COOH$	163.38
27	acetyl chloride		$CCl_3 \cdot COCl$	181.83
28	aniline (v.) (1, 2, 3, 4)		$C_6H_2Cl_3 \cdot NH_2$	196.41
29	" (uns.) (1, 2, 4, 5)		$C_6H_2Cl_3 \cdot NH_2$	196.41
30	" (sym.) (1, 2, 4, 6)		$C_6H_2Cl_3 \cdot NH_2$	196.41
31	benzene (v.) (1, 2, 3)		$C_6H_3Cl_3$	181.40
32	" (uns.) (1, 2, 4)		$C_6H_3Cl_3$	181.40

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form and color	Sp. gr. $H_2O = 1$ (A)Air = 1	Melting-point °C	Boiling-point °C	Solubility in gms. per 100 c.c. of		
					Water	Alcohol	Ether
1	colorl. liq.	$1.161_{15}^{15°}$	.....	258–9	sl. s.	∞	∞
2	tetrag. need.	.....	58	.....	s.	.....	s.
3	or. red.	.....	143.5	.....	.....	v. s.	v. s.
4	cryst.	.....	103	330	v. s.	v. s.	v. s.
5	leaf. f. chl.	.....	44	abt. 340	v. s.	v. s.	v. sl. s.; s. chl.
6	need.	.....	.....	.....	s. h.	i.	i.
7	warts. f. w.	.....	.....	.....	v. s. h.	v. sl. s. h.	i.
8	need.	.....	.....	257	.....	.....	.....
9	liq.	.....	.....	257	.....	.....	.....
10	need.	.....	121	260	s.	s.	sl. s.
11	need.	.....	224–5	subl.	s. CS_2	v. sl. s.	v. sl. s
12	monocl. f. al.	.....	91.3	.....	v. sl. s.	s. h.	s.
13	colorl. tab.	.....	135	245 d.	v. s.	v. s.	v. s.
14	sm. need.	.....	119	.....	i.	sl. s.	s.
15	need.	.....	119.6	278	i.	sl. s. h.	.....
16	monocl. pr.	$2.658^{16°}$	87.4	.....	.....	.....	.....
17	need.	.....	44	275–6	.....	sl. s.	.....
18	pr.	$2.436^{23°}$	16	220	i.	.....	.....
19	monocl. pr.	.....	92; (96)	subl.	sl. s.	v. s.	s.
20	need.	.....	111	.....	sl. s.	v. s.	s.
21	.....	$0.778^{20°}$	.....	216.5	.....	v. s.	v. s.
22							
23	colorl. rhomb.	.....	166	dec.	v. s.	v. s.	sl. s.
24	.....	1.288	.....	197	0.5	∞	∞
25	tab. f. w.	.....	141	239	v. sl. s.	v. s.	v. s.
26	colorl. rhomb.	$1.630^{60°}$	57.3	195	v. s.	s.	s
27	colorl. liq.	.....	.....	118	.....	.....	.....
28	need. f. lgr.	.....	67.5	292	s. lgr.	.....	.....
29	need. f. lgr.	.....	95–6	abt. 270	s. lgr.	.....	.....
30	lng. need. f. lgr.	.....	77.5	262	.....	s.	v. s. lgr.
31	pl. f. al.	.....	53.4	218–9	.....	sl. s.	.....
32	colorl.	$1.466^{10°}$	16–7	213	i.	.....	.....

No.	Name	Synonyms	Formula	Mol. wt.
1	benzene (sym.) (1, 3, 5)	.....	$C_6H_3Cl_3$	181.40
2	benzoic acid (uns.) (1, 2, 4, 5)	.....	$C_6H_2Cl_3 \cdot COOH$	225.40
3	" (v.) (1, 2, 3, 4)	.....	$C_6H_2Cl_3 \cdot COOH$	225.40
4	" COOH, Cl (1, 3, 4, 5)	.....	$C_6H_2Cl_3 \cdot COOH$	225.40
5	ethane (α)	.....	$CCl_3 \cdot CH_3$	133.40
6	" (β)	.....	$CH_2Cl \cdot CHCl_2$	133.40
7	ethyl alcohol ...	.....	$CCl_3 \cdot CH_2OH$	149.40
8	ethylene	.....	$CHCl : CCl_2$	131.38
9	hydrine	glyceryl trichlorhydrine	$CH_2Cl \cdot CHCl \cdot CH_2Cl$	147.42
10	hydroquinone ...	.....	$(HO)_2 \cdot C_6H \cdot Cl_3$ (2, 3, 5)	213.40
11	methane.	See *chloroform*		
12	methyl-chloroformate	disphosgene	$Cl \cdot COO \cdot CCl_3$	197.83
13	phenol	.....	$HO \cdot C_6H_2 \cdot Cl_3$ (2, 4, 6)	197.40
14	" OH, Cl (1, 2, 3, 5)	.....	$HO \cdot C_6H_2Cl_3$	197.40
15	propane (1, 2, 3).	See *trichlorhydrine*		
16	quinone	.....	$O_2 \cdot C_6H \cdot Cl_3$ ..... (2, 3, 5)	211.38
17	Tricyanogen chloride	cyanuric chloride	$C_3N_3Cl_3$	184.40
18	Tridecane (n.) ...	.....	$C_{13}H_{28}$	184.22
19	Tridecylene	.....	$C_{13}H_{26}$	182.21
20	Triethyl amine	.....	$(C_2H_5)_3N$	101.13
21	arsine	.....	$(C_2H_5)_3As$	162.08
22	benzene (sym.) .	.....	$C_6H_3 \cdot (C_2H_5)_3$ (1, 3, 5)	162.14
23	carbinol	.....	$(C_2H_5)_3 \cdot COH$	116.13
24	phosphine	.....	$(C_2H_5)_3 \cdot P$	118.15
25	phosphine oxide	.....	$(C_2H_5)_3PO$	134.15
26	phosphine sulfide	.....	$(C_2H_5)_3PS$	150.21
27	phosphite	.....	$(C_2H_5)_3PO_3$	166.15
28	siltcol	.....	$(C_2H_5)_3SiOH$	132.19
29	silicol ethylether	.....	$(C_2H_5)_3SiOC_2H_5$	160.22
30	silicon hydride ..	.....	$(C_2H_5)_3SiH$	116.19
31	silicon oxide	.....	$[(C_2H_5)_3Si]_2O$	246.36
32	Triethylenediamine	.....	$(C_2H_4)_3N_2$	112.11
33	Trihydroxy-benzoic acid	pyrogallol carbosylic acid	$(HO)_3C_6H_2COOH$ (2, 3, 4)	170.05
34	benzophenone ..	.....	$C_{13}H_{10}O_4$	230.08
35	glutaric acid .... (d. or l.)	.....	$(CHOH)_3(COOH)_2$.	180.06
36	glutaric acid (i.)	.....	$(CHOH)_3(COOH)_2$.	180.06
37	methylene (α) ..	.....	$C_3H_6O_3$	90.05
38	pyridine (sym.) .	.....	$NC_5H_2(OH)_3$ (2, 4, 6)	127.05
39	Triiodo-acetic acid	.....	$CI_3 \cdot COOH$	437.80
40	benzene (uns.) (1, 2, 4)	.....	$C_6H_3I_3$	455.82

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form and color	Sp. gr. H_2O = 1 (A)Air = 1	Melting-point °C	Boiling-point °C	Solubility in gms. per 100 c.c. of		
					Water	Alcohol	Ether
1	lng.need.	.....	63.4	208.5	.....	s.	.....
2	sm. need. f. w.	.....	163	subl.	s h.	s.	.....
3	need. f. al.	.....	129	.....	sl. s.	.....	.....
4	need. f. al.	.....	203	subl.	s. h.	s.	s. gbz.
5	colorl. liq.	$1.325^{26°}$	.....	74.5	i.	∞	∞
6	" "	$1.478^{0°}$	.....	114	i.	∞	∞
7	rhomb. tab.	$1.550^{23°}$	18	151	sl. s.	∞	∞
8	colorl. liq.	$1.460^{\frac{25}{25}°}$	−70	87.1	i.	∞	∞
9	.....	1.417	.....	158	i.	.....	.....
10	prisms	.....	134	subl.	$0.6^{15°}$	v. s.	v. s.
11							
12	.....	.....	.....	127.5–80	.....	.....	.....
13	rhomb.	.....	68	244	$0.08^{25°}$	v. s.	v. s.
14	lng.need. f. al.	.....	53–4	252–3	sl. s. h.	s.	s.
15							
16	yel. leaf.	.....	165–6	.....	i.	sl. s.	v. s.
17	.....	.....	146	190	sl. s.	v. s.	v. s.
18	colorl. liq.	$0.757^{20°}$	−6.2	234	i.	v. s.	v. s.
19	" "	0.845	.....	233	i.	v. s.	v. s.
20	colorl. liq.	0.733	.....	89	v. s.	∞	∞
21	.....	1.151	.....	140 d.	.....	.....	.....
22	colorl. liq.	$0.864^{17°}$	.....	214–8	i.	v. s.	v. s.
23	colorl. liq.	$0.840^{20°}$	.....	140–2	sl s.	s.	s.
24	colorl. liq.	0.812	.....	127	i	s.	s.
25	liq.	.....	.....	240	.....	.....	.....
26	.....	.....	94	.....	.....	.....	.....
27	.....	.....	.....	155.5–6.5	i.	v. s.	v. s.
28	liq.	$0.8709^{0°}$	.....	154	i.	.....	.....
29	liq.	$0.8403^{0°}$	.....	153	.....	.....	.....
30	liq.	$0.751^{0°}$	.....	107	.....	.....	.....
31	liq.	$0.859^{0°}$	.....	231	.....	.....	.....
32	liq.	.....	.....	210	.....	.....	.....
33	need. f. w.	.....	d. 195–200	.....	$0.13^{12°}$	s.	v. s.
34	yel. leaf	.....	133	.....	.....	s. h.	.....
35	colorl. f. acet.	.....	128	.....	v. s.	v. s.	s. acet.
36	colorl.tab. f. acet.	.....	152 d.	.....	v. s.	v. s. h.	s. acet.
37	need.	.....	61	subl.	s.	s.	s.
38	cryst....	.....	d. 220–30	.....	s.	.....	.....
39	yel. leaf.	.....	150 d.	.....	s.	.....	.....
40	sm. need.	.....	76	subl.	.....	s.	.....

PHYSICAL CONSTANTS OF

No.	Name	Synonyms	Formula	Mol. wt.
1	Triisobutyl amine	.....	$(C_4H_9)_3N$	185.22
2	Trimellitic acid...	.....	$C_6H_3\cdot(COOH)_3$ (1, 2, 4)	210.05
3	Trimesic acid (sym.)	.....	$C_6H_3\cdot(COOH)_3$ (1, 3, 5)	210.05
4	Trimethyl-acetic acid	.....	$(CH_3)_3C\cdot COOH$ . .	102.08
5	amine.....	.....	$(CH_3)_3N$	59.08
6	amine hydrochloride	.....	$(CH_3)_3N\cdot HCl$	95.54
7	arsine.....	.....	$(CH_3)_3As$	120.03
8	benzoic acid....	.....	$(CH_3)_3\cdot C_6H_2\cdot COOH$ (1, 2, 4, 5)	164.10
9	" "	β-isodurylic acid..	$(CH_3)_3\cdot C_6H_2\cdot COOH$ (1, 3, 5)	164.10
10	carbinol.....	.....	$(CH_3)_3COH$	74.08
11	citrate.....	.....	$C_6H_5O_7(CH_3)_3$	234.11
12	ethylene.....	.....	$(CH_3)_2C:CH(CH_3)$	70.08
13	phosphate.....	.....	$(CH_3)_3PO_4$	140.10
14	phosphine.....	.....	$(CH_3)_3P$	76.10
15	pyridine.	See *collidine* (γ)		
16	quinoline (α, β, γ)	.....	$C_{12}H_{13}N$	171.11
17	" (o, p, a, n)	.....	$C_{12}H_{13}N$	171.11
18	" (α, o, m)	.....	$C_{12}H_{13}N$	171.11
19	" (α, o. p.)	.....	$C_{12}H_1N$	171.11
20	" (α, γ, p.)	.....	$C_{12}H_{13}N$	171.11
21	urea.....	.....	$(CH_3)NH\cdot CO\cdot N(CH_3)_2$	102.10
22	Trimethylene....	cyclo-propane....	C_3H_6	42.05
23	bromide.....	.....	$CH_2Br\cdot CH_2\cdot CH_2Br$	201.88
24	diamine.....	.....	$NH_2\cdot(CH_2)_3\cdot NH_2$...	74.10
25	dicarboxylic acid (α)	.....	$CH_2\cdot CH_2\cdot C(COOH)_2$	130.05
26	glycol.....	.....	$CH_2(OH)\cdot CH_2\cdot CH_2(OH)$	76.06
27	Trimyristine.	See *myristin*		
28	Trinitraniline....	" T. N. A. ".....	$C_6H_2(NO_2)_3NH_2$	228.06
29	Trinitro-acetonitrile	trinitrocyanmethane	$C(NO_2)_3CN$	176.03
30	benzene (1, 2, 4)	.....	$C_6H_3\cdot(NO_2)_3$	213.05
31	" (sym.) (1, 3, 5)	.....	$C_6H_3\cdot(NO_2)_3$	213.05
32	chlorobenzene (sym.)	picryl chloride....	$C_6H_2\cdot Cl(NO_2)_3$	247.52
33	cresol.....	.....	2, 4, 6–$(NO_2)_3\cdot C_6H\cdot CH_3(OH)$ (1, 3)	243.06
34	naphthalene....	.....	$C_{10}H_5\cdot(NO_2)_3$ (1, 2, 5)	263.06
35	"	.....	$C_{10}H_5\cdot(NO_2)_3$ (1, 3, 5)	263.06

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form and color	Sp. gr. $H_2O = 1$ (A) Air = 1	Melting-point °C	Boiling-point °C	Solubility in gms. per 100 c.c. of		
					Water	Alcohol	Ether
1	colorl. liq.	$0.785^{21°}$	.....	184–6	i.	v. s.	∞
2	colorl.	.....	216 d. (228)	.....	s. h.	.....	s.
3	colorl. pr. f. w.	.....	345–50	subl. <300	s.	v. s.	s.
4	colorl.	$0.905^{5°}$	35.5	163.7	2.2	v. s.	v. s.
5	colorl.	$0.662^{-6°}$	.....	3.5	v. s.	v. s.	s.
6	.....	.....	271–5 d.	.....	v. s.	s.	i.
7	liq.	.....	.....	<100	sl. s.	.....	.....
8	colorl. need. f. bz.	.....	149–50	.....	v. sl. s. h.	v. s.	v. s.
9	colorl.	.....	152	.....	v. sl. s.	v. s.	v. s.
10	colorl.	.....	25	82.9	v. s.	s.	∞
11	colorl. tricl.	.....	78.5–9.0	283–7 d.	.....	.....	.....
12	.....	$0.6783^{0°}$	.....	36–8	.....	.....	.....
13	.....	1.220	.....	197	.....	s.	s.
14	.....	>1	.....	40	i.	.....	s.
15							
16	.....	.....	abt. 65	285	.....	.....	.....
17	pr.	.....	43	285–7	v. s.	v. s.	v. s.
18	monocl.	.....	.....	.....	.....	.....	.....
19	monocl. pr. f. lgr.	.....	46	$260^{71.9mm.}$	i.	v. s.	v. s. lgr.
20	need. f. w.	.....	63–4	.....	s	.....	.....
21	.....	.....	75.5	232.5	v. s.	v. s.	s
22	gas.....	.....	–126.6	–34	i.	v. s.	v. s
23	liq.	$1.973^{17°}$	.....	165	.....	s.	s.
24	.....	.....	.....	135–6	.....	∞	∞
25	pr or need.	.....	139	.....	v. s.	.....	s.
26	visc. liq.	$1.053^{18°}$	.....	214	∞	.....	.....
27							
28	monocl. yel. need.	.....	188	exp.	.....	s.	.....
29	.....	.....	41.5	exp. 220	d.	d.	s.
30	yel.	.....	57.5	.....	sl. s.	.....	.....
31	yel. pl. f. bz.	1.688	122	.....	$0.04^{16°}$	$1.9^{16°}$	v. s.
32	.....	.....	85°	.....	.....	.....	.....
33	yel. need. f w.	.....	105–6	.....	$0.22^{20°}$; $0.81^{100°}$	v. s.	v. s.
34	colorl. need. f. al.	.....	112–3	.....	.....	s.	.....
35	yel monocl. f. chl.	.....	122	.....	v. s. chl.	v. s.	v. s. glac. acet. a.

No.	Name	Synonyms	Formula	Mol. wt.
1	Trinitro-naphthalene		$C_{10}H_5 \cdot (NO_2)_3$ (1, 3, 8)	263.06
2	orcinol		$C_6(NO_2)_3CH_3(OH)_2$	259.06
3	phenol (sym.)	See *picric acid*		
4	" (2, 3, 6) (γ)		$(NO_2)_3 \cdot C_6H_2OH$	229.05
5	" (3, 4, 6) (β)		$(NO_2)_3 \cdot C_6H_2OH$	229.05
6	resorcinol (2, 4, 6)	stypynic acid	$C_6H(NO_2)_3(OH)_2$	245.05
7	tertiary-butyl-toluene (2, 4, 6)	artificial musk	$(NO_2)_3C_6H \cdot CH_3$ $[C(CH_3)_3]$	283.13
8	toluene (sym.)	" T. N. T."	$CH_3 \cdot C_6H_2 \cdot (NO_2)_3$ (1, 2, 4, 6)	227.06
9	"		$CH_3 \cdot C_6H_2 \cdot (NO_2)_3$ (1, 2, 3, 4)	227.06
10	"		$CH_3 \cdot C_6H_2 \cdot (NO_2)_3$ (1, 2, 4, 5)	227.06
11	triphenyl carbinol		4, 4', 4"-$(NO_2 \cdot C_6H_4)_3 \cdot COH$	395.13
12	" methane		4, 4', 4"-$(NO_2 \cdot C_6H_4)_3 \cdot CH$	379.13
13	xylene		$(CH_3)_2 \cdot C_6H \cdot (NO_2)_3$ (1, 4) (2, 4, 6)	241.08
14	"		$(CH_3)_2 \cdot C_6H \cdot (NO_2)_3$ (1, 3) (2, 4, 6)	241.08
15	Trional		$C_8H_{18}O_4S_2$	242.27
16	Trioxymethylene	metaformaldehyde	$C_3H_6O_3$	90.05
17	"	(isomer of above)	$C_2H_6O_2$	90.05
18	Tripalmitin	See *palmitin*		
19	Triphenyl-acetic acid		$(C_6H_5)_3C \cdot COOH$	288.13
20	amine		$(C_6H_5)_3N$	245.13
21	benzene		$C_6H_3 \cdot (C_6H_5)_3$ (1, 3, 5)	306.14
22	carbinol		$(C_6H_5)_3COH$	260.13
23	guanidine (α)		C_6H_5N: $C(NHC_6H_5)_2$	287.16
24	" (β)		$HN:C(NHC_6H_5)N(C_6H_5)_2$	287.16
25	methane		$(C_6H_5)_3CH$	244.13
26	methane carboxylic acid (o.)		$(C_6H_5)_2CH(C_6H_4) \cdot COOH$	288.13
27	phosphine		$(C_6H_5)_3P$	262.15
28	Triquinoyl		$C_6H_{16}O_{14}$	312.13
29	Tripropylamine		$(C_3H_7)_3N$	143.18
30	Tristearine	See *stearine*		
31	Trithiocarbonic acid		$CS(SH)_2$	110.21
32	Tropacocaine		$C_8H_{14}ON \cdot CO \cdot C_6H_5$	245.16
33	hydrochloride		$C_8H_{14}ON \cdot CO \cdot C_6H_5 \cdot HCl$	281.62

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form and color	Sp. gr. H_2O = 1 (A)Air = 1	Melting-point °C	Boiling-point °C	Solubility in gms. per 100 c.c. of		
					Water	Alcohol	Ether
1	monocl. f. chl.	.....	218	.....	v. sl. s. chl.	$0.046^{23°}$ (88%)	v. sl. s.
2	lng. yel need.	.....	147	.....	.....	sl. s.	.....
3							
4	need.	.....	117	.....	s. s.	v. s.	v. s.
5	need.	.....	96	.....	.....	v. s.	v. s.
6	yel. pr.	.....	174–5	.....	sl s.	s.	sl. s
7	need. f. al.	.....	96–7	.....	.....	s.	.....
8	colorl. monocl. f. al.	1.654	82 (80.8)	.....	0.02^{15}	v. sl. s. c. v. s. h.	sl. s.
9	leaf. f. al.	1.62	112	.....	i.	sl. s. c.	v. s.
10	.....	.....	104	.....	i.	sl. s. c.	v. s
11	cryst. f. bz.	.....	171–2	.....	s. bz.	sl. s. h.	sl. s.
12	sc. f. bz.	.....	206–7 (203)	.....	v. sl. s. glac. acet. a.	v. sl. s. bz	v. sl. s.
13	need.	.....	139	.....	v. sl. s.	.....	.....
14	need.	.....	182	.....	i.	v. sl. s. c.;	sl. s.
15	colorl. tab.	.....	76	dec.	0.3	v. s.	v. s.
16	wh.	.....	171	.....	i.	i.	i.
17	long need.	.....	60–1	subl.	s	s.	s.
18							
19	monocl. pr.	.....	264 d.	.....	sl. s.	s.	sl. s.
20	monocl. pr. f eth.	.....	127	347–8	s. acet.	sl. s.	v. s. bz.
21	rhomb. tab. f. eth.	1.206	169–70	.....	s. bz.	sl. s.	sl. s.
22	hex. pr.	.....	162	abt. 360	v. s. bz.	v. s.	v. s.
23	need. or pr. f. al.	.....	143	d.	v. sl. s.	s. h.	.....
24	tab.	.....	131	.....	v sl. s.	v. s.	v. s.
25	colorl. leaf.	$1.057^{25°}_{25°}$	92	258–9	v. s. chl.	sl. s. c.; v. s. h.	v. s.
26	need. f. al.	.....	161–2	.....	i.	s.	s.
27	monocl. pr.	.....	75 (79)	abt. 360	i.	s.	v. s.
28	micr.need.	.....	95	.....	s. h.	i.	i.
29	colorl. liq.	.....	.....	157	v. sl. s.	∞	s.
30							
31	br. oil.	.....	γ 76	57 d.	i. d.	s.	s.
						Na_2CO_3	
32	glit. cryst. f. eth.	.....	49	.....	sl. s.	v. s.; v. s. bz.	v. s.; v. s. chl.
33	need.	.....	271 (283 d.)	.....	s.	.....	.....

No.	Name	Synonyms	Formula	Mol. wt.
1	Tropaic acid	-phenylhydracrylic acid	$C_6H_5CH(COOH)CH_2OH$	166.08
2	Tropine		$C_3H_{15}ON$	141.13
3	Tryptophane	β-indole alanine	$C_6H_4NHCH{:}C\cdot CH_2CH(NH_2)COOH$	204.11
4	Tyrosine	p-hydroxyphenyl alanine	$HO\cdot C_6H_4\cdot CH_2\cdot CH(NH_2)COOH$	181.10
5	Umbellic acid		$C_9H_{10}O_4$	182.08
6	Umbelliferone		$C_9H_6O_3$	162.05
7	Undecane (n.)		$C_{11}H_{24}$	156.19
8	Undecylene		$C_{11}H_{22}$	154.18
9	Undecylenic acid		$CH_3\cdot C_2H_2\cdot C_7H_{14}\cdot COOH$	184.16
10	Undecylic acid		$C_{10}H_{21}\cdot COOH$	186.18
11	Uramil	murexan	$CONHCONHCOCH\cdot NH_2$	143.06
12	Urea	carbamide	$NH_2\cdot CO\cdot NH_2$	60.05
13	Urethane	ethyl carbamate	$NH_2\cdot COO\cdot C_2H_5$	89.06
14	Uric acid		$C_5H_4O_3N_4$	168.06
15	Usnic acid (d.)		$C_{18}H_{16}O_7$	344.13
16	" " (l.)		$C_{18}H_{16}O_7$	344.13
17	Uvic acid	pyrotritaric acid	$(CH_3)_2C_4HO\cdot COOH$	140.06
18	Uvitic acid (1, 3, 5)		$CH_3\cdot C_6H_3(COOH)_2$	180.06
19	Uvitonic acid	o-picoline-o, p-dicarboxylic acid	$CH_3\cdot C_5H_2N(COOH)_2$	181.06
20	Valeramide		$C_4H_9CONH_2$	101.09
21	Valeric acid		$CH_3\cdot(CH_2)_2\cdot COOH$	102.08
22	aldehyde		$C_4H_9\cdot CHO$	86.08
23	anhydride		$(C_5H_9O)_2\cdot O$	186.14
24	Valero nitrile.	See *butyl cyanide*		
25	Valerylene		$CH_3C:C\cdot CH_2\cdot CH_3$	68.06
26	Valylene		$CH_2{:}C(CH_3)C:CH$	66.04
27	Vanillic acid		$CH_3O\cdot C_6H_3(OH)COOH$ (3, 4, 1)	168.06
28	alcohol		$CH_3O\cdot C_6H_3(OH)CH_2OH$ (3, 4, 1)	154.08
29	Vanilline		$CH_3O\cdot C_6H_3(OH)CHO$ (3, 4, 1)	152.06
30	Veratrine	cevadine	$C_{32}H_{49}NO_9$	591.46
31	Veratrol (o.)		$C_6H_4\cdot(OCH_3)_2$	138.08
32	Veronal		$C_8H_{12}O_3N_2$	184.14
33	Vinyl acetic acid		$CH_2:CH\cdot CH_2\cdot COOH$	86.06
34	amine		$C_2H_3NH_2$	43.06
35	bromide		$CH_2:CHBr$	106.96
36	chloride		$CH_2:CHCl$	62.48

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form and color	Sp. gr. $H_2O = 1$ (A) Air = 1	Melting-point °C	Boiling-point °C	Solubility in gms. per 100 c.c. of		
					Water	Alcohol	Ether
1	need. or pl.	.....	117–8	d.	s.	s.	s.
2	need.	.....	63	229	v. s.	v. s.	v. s.
3	.....	.....	.....	.....	s.	i.	i.
4	sm. silk. need.	.....	abt. 295 d.	.....	$0.04^{17°}$; $0.65^{100°}$	$0.01^{17°}$; i. abs.	i.
5	.....	.....	125 d.	.....	sl. s.	s.	s.
6	.....	.....	240	subl.	s. h.	s.	s.
7	colorl. liq.	$0.741^{20°}$	−26.5	194.5	i.	∞	∞
8	colorl. liq.	$0.772^{20°}$	.....	abt. 195	i.	∞	∞
9	colorl.	$0.907^{24°}$	24.5	.....	.....	.....	.....
10	scales	.....	28.5	212.5 100mm.	i.	v. s.	.....
11	need.	.....	.....	.....	sl. s. h.	s. NH_4OH	.....
12	tetr.	1.323	132.6	dec.	v. s.	5 c.	sl. s.
13	colorl. need. f. lgr.	$0.986^{21°}$	49–50	180	v. s. c.	v. s.	v. s.
14	scales	1.85 +	dec.	.....	0.06 h.	i.	i.
15	yel. pr.	.....	203	d.	i.	v. sl. s.	sl. s.
16	yel. monocl. pr.	.....	192–3	.....	i.	v. sl. s.	$0.3^{20°}$
17	colorl. need.	.....	135	.....	$0.25^{100°}$	v. s.	v. s.
18	colorl. need. f. w.	.....	287–8	subl.	sl. s.	v. s.	v. s.
19	powd.	.....	274	.....	v. sl. s.	.....	.....
20	.....	.....	126–7	230–2	s.	s.	s.
21	colorl. liq.	$0.942^{20°}$	−58.5	186–6.4	$3.7^{18°}$	∞	∞
22	colorl. liq.	$0.819^{11°}$	.....	103.4	sl. s.	.....	.....
23	colorl. liq.	.....	.....	215	dec. h.	.....	.....
24							
25	.....	.....	.....	55.5–6.0	.....	.....	.....
26	.....	.....	.....	50	.....	.....	.....
27	colorl. need.	.....	207	.....	$0.12^{14°}$	v. s.	v. s.
28	colorl. need.	.....	115	dec.	v. s. h.	v. s.	v. s.
29	colorl. need. f. w.	.....	80–1	.....	1.c.; 5 h.	v. s.	v. s.
30	cryst.	.....	205	.....	i.	s.	s.
31	colorl.	1.086	23	205–6	sl. s.	s.	s.
32	cryst. powd.	.....	191 (182)	.....	$0.69^{20°}$; $8.3^{100°}$	s. ∞	v. s. ∞
33	.....	.....	<−20	168	s.	.....	.....
34	.....	.....	.....	56	.....	s. ∞	..... ∞
35	.....	1.517	16(23)	.....	i.	.....	s. .....
36	.....	.....	.....	−18	.....	s.	.....

No.	Name	Synonyms	Formula	Mol. wt.
1	Vinyl ether		$CH:CH_2{\cdot}O{\cdot}CH:CH_2$	70.03
2	ethylether		$C_2H_3OC_2H_5$	72.06
3	sulfide		$CH_2:CH{\cdot}S{\cdot}CH:CH_2$	86.11
4	Violuric acid		$CONHCONHCO{\cdot}C(NOH)$	157.03
5	Xanthene		$C_{13}H_{10}O$	182.08
6	Xanthine		$C_5H_4O_2N_4$	152.06
7	Xanthogenamide		$CS(OC_2H_5)NH_2$	105.13
8	Xanthogenic acid		$CS(OC_2H_5)SH$	122.18
9	Xanthone	diphenylene ketone oxide	$CO:(C_6H_4)_2:O$	196.06
10	Xanthopurpurin		$C_6H_4(CO)_2C_6H_2(OH)_2$	240.06
11	Xylene (o.)	xylol (o.)	$C_6H_4{\cdot}(CH_3)_2$	106.08
12	" (m.)	" (m.)	$C_6H_4{\cdot}(CH_3)_2$	106.08
13	" (p.)	" (p.)	$C_6H_4{\cdot}(CH_3)_2$	106.08
14	sulfonic acid (1, 2, 4)		$C_6H_3(CH_3)_2SO_3H + 2H_2O$	222.18
15	Xylenol (1, 2, 3)		$(CH_3)_2{\cdot}C_6H_3{\cdot}OH$	122.08
16	" (1, 2, 4)		$(CH_3)_2{\cdot}C_6H_3{\cdot}OH$	122.08
17	" (1, 3, 2)		$(CH_3)_2{\cdot}C_6H_3{\cdot}OH$	122.08
18	" (1, 3, 4)		$(CH_3)_2{\cdot}C_6H_3{\cdot}OH$	122.08
19	" (1, 3, 5)		$(CH_3)_2{\cdot}C_6H_3{\cdot}OH$	122.08
20	" (1, 4, 3)		$(CH_3)_2{\cdot}C_6H_3{\cdot}OH$	122.08
21	Xylic acid. See *dimethyl benzoic acid* (2, 4)			
22	Xylidine (1, 2, 3)	dimethyl-amino benzene (1, 2, 3)	$(CH_3)_2{\cdot}C_6H_3{\cdot}NH_2$	121.10
23	" (1, 2, 4)	dimethyl-amino benzene (1, 2, 4)	$(CH_3)_2{\cdot}C_6H_3{\cdot}NH_2$	121.10
24	" (1, 3, 2)	dimethyl-amino benzene (1, 3, 2)	$(CH_3)_2{\cdot}C_6H_3{\cdot}NH_2$	121.10
25	" (1, 3, 4)	dimethyl-amino benzene (1, 3, 4)	$(CH_3)_2{\cdot}C_6H_3{\cdot}NH_2$	121.10
26	" (1, 3, 5)	dimethyl-amino benzene (1, 3, 5)	$(CH_3)_2{\cdot}C_6H_3{\cdot}NH_2$	121.10
27	" (1, 4, 3)	dimethyl-amino benzene (1, 4, 3)	$(CH_3)_2{\cdot}C_6H_3{\cdot}NH_2$	121.10
28	Xylose		$C_5H_{10}O_5$	150.08
29	Xyloquinone (o.)		$(CH_3)_2C_6H_2O_2$	136.06
30	" (m.)		$(CH_3)_2C_6H_2O_2$	136.06
31	" (p.)	See *phlorone*		
32	Xylorcin (m.) (1, 3, 4, 6)		$(CH_3)_2C_6H_2(OH)_2$	138.06
33	Xylyl hydrazine (1, 3, 4)		$(CH_3)_2C_6H_3{\cdot}NH{\cdot}NH_2$	136.10
34	Yohimbine		$C_{22}H_{28}O_3N_2$	368.22
35	Zinc ethyl		$Zn(C_2H_5)_2$	123.48
36	methyl	zinc methide	$Zn(CH_3)_2$	95.44

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form and color	Sp. gr. $H_2O = 1$ (A)Air = 1	Melting-point °C	Boiling-point °C	Solubility in gms. per 100 c.c. of		
					Water	Alcohol	Ether
1	colorl. liq.	.....	.....	39	.....	s.	∞
2	.....	$0.7625^{14.5°}$	.....	35.5	sl. s.	s.	.....
3	oil	0.913	.....	1.01	sl. s.	∞	∞
4	.....	.....	.....	.....	s. h.	s.	.....
5	leaf. f. al.	.....	99	312–15	v. sl. s.	sl. s.	s.
6	yel wh. powd.	.....	>360	.....	$0.067^{100°}$	$0.033^{17°}$	v. s. alk.
7	monocl.	.....	38	.....	.....	s.	.....
8	liq.	$> H_2O$	.....	24 d.	i.	.....	.....
9	lng. need. f. al.	.....	173–4	250	sl. s. h.	s. h.	sl. s. lgr.
10	.....	.....	252–3	subl.	.....	.....	.....
11	colorl. liq.	$0.881^{20°}$	–28	142	i.	v. s.	v. s.
12	colorl. liq.	$0.866^{20°}$	–54	139.2	i.	v. s.	v. s.
13	colorl. monocl.	.....	15	138	i.	s.	v. s.
14	tab.	.....	d.	.....	s.	.....	.....
15	long. need f. w.	.....	75	218	s.	s.	.....
16	need. f. w.	.....	65	225	s.	s.	.....
17	colorl. leaf.	.....	49	211.2	s. h.	s.	.....
18	colorl. need.	.....	26	211.5	v. sl. s.	∞	∞
19	need. f. w.	.....	64 or 68	219.5	sl. s.	s.	.....
20	colorl. monocl.	1.169	74.5	211.5	s.	s.	v. s.
21							
22	liq.	0.991	<–15	224–6	v. sl. s.	v. s.	v. s.
23	monocl. tab.	$1.076^{17°}$	49	225	sl. s	v. s. lgr.	.....
24	liq.	0.980	.....	216 (212)	.....	.....	.....
25	liq.	.....	.....	216.5 (212)	v. sl. s.	.....	.....
26	liq.	$0.993^{0°}$	.....	220–1	.....	.....	.....
27	.....	.....	15.5	217–8	v. sl. s.	0.980	.....
28	need.	.....	150–3	.....	$117^{20°}$	v. sl. s. c.	v. ss. l.
29	yel.need.	.....	55	subl.	sl. s.	s.	s
30	.....	.....	72–3	.....	.....	.....	.....
31							
32	micr.cryst	.....	124–5	276–9	s.	s.	s.
33	need. f. eth.	.....	85	.....	.....	.....	v. s.
34	colorl. need.	.....	234–4.5	.....	v. sl. s.	v. s.	s.; s. chl.
35	colorl. liq.	1.18	–28	118	dec.	dec	s.
36	.....	1.39	–40	46	dec.	dec.	.....

CONSTANTS OF VEGETABLE AND ANIMAL

No.	Common name	Scientific name	Class†
1	Almond	*Prunus amygdalus*	I
2	Beef marrow	*Adeps bovis*	IX
3	Beef tallow	*Adeps bovis*	IX
4	Beechnut	*Fagus sylvatica F. Americana*	V
5	Beeswax	*Apis mellifera*	XII
6	Black mustard	*Sinapis nigra*	II
7	Bone fat	*Sevum ossis*	IX
8	Butter fat	*Vaccae lactis adeps*	IX
9	Candlenut	*Aleurites moluccana*	VI
10	Candlenut	*Aleurites triloba*	VI
11	Carnauba wax	*Corypha cerifera*	XI
12	Castor	*Ricinus communis*	III
13	Chaulmoogra	*Taraktogenos Kurzii*	V
14	Chaulmoogra	U. S. P. 10th Revision	V
15	Chinese insect wax	*Coccus cerifera*	XII
16	Chinese vegetable tallow	*Stillingia sebifera*	VIII
17	Coconut	*Cocos butyracea, C. nucifera*	VIII
18	Cocoa butter (Cacao)	*Theobroma cacao*	VIII
19	Cod liver	*Gadus morrhua*	VII
20	Corn (maize)	*Zea mais*	V
21	Cotton seed	Species *Gossypium*	V
22	Cotton seed stearin	*Gossypium*	VIII
23	Croton	*Croton tiglium*	V
24	Goose fat	*Anser cinereus*	IX
25	Grape seed	*Vites vinefera*	III
26	Hazelnut	*Corylus avellana*	I
27	Hemp seed	*Cannabus sativa*	VI
28	Horse fat	*Equus caballus*	IX
29	Human fat		IX
30	Japan wax	*Rhus succedaneum*	VIII
31	Lard oil	*Oleum adipis*	IV
32	Lard oil (fatty tissue)	*Adeps*	IX
33	Laurel (bayberry)	*Laurus nobilis*	VIII
34	Linseed	*Linum usitatissimum*	VI
35	Menhaden	*Alosa menhaden (Brevortia tyrannus)*	VII
36	Mutton tallow	*Adeps ovis*	IX
37	Myrtle wax	*Myrica cerifera (M. Carolinensis)*	VIII
38	Neat's foot	*Oleum pedis bovis*	IV
39	Nutmeg butter (mace)	*Myristica officinalis*	VIII
40	Olive	*Olea Europaea sativa*	I
41	Palm	*Elaeis guineensis*	VIII
42	Palm kernel	*Elaeis guineensis* (W. Africa)	VIII
43	Palm kernel	*Elaeis guineensis* (S. America)	VIII
44	Peach kernel	*Amygdalus Persica*	I
45	Peanut	*Arachis hypogaea*	I
46	Poppy seed	*Papaver somniferum*	VI
47	Porpoise (body oil)	*Delphinus phocaena*	VII
48	Pumpkin seed	*Cucurbita pepo*	V
49	Rabbit fat	*Lepus cuniculus*	IX
50	Rape seed	*Brassica campestris*	II
51	Safflower	*Carthamus tinctorius*	VI
52	Seal	*Species Phoca*	VII
53	Sesame	*Sesamum indicum*	V

OILS, FATS AND WAXES

No.	Specific gravity at $\frac{15°}{15°}$ C.	Solidifying point °C.	Saponification value	Iodine value	Hehner's number
1	0.914–0.921	−15 to −20	183.3–207.6	93–103.4	96.0
2	0.9311–0.938	31 to 29	196–199.6	39–55.4	.....
3	0.895	31 to 38	196–200	35.4–42.3	96–96.5
4	0.922	−17	191–196	97–111	95–96
5	0.961–0.968	60.5 to 62	88–96	8.8–10.7	.....
6	0.915–0.919	−17	173–175	99–110	96
7	0.914–0.916	15 to 17	190–196	50–55	94–95
8	$0.907–0.912^{\frac{40°}{15°}}$	19 to 24.5	210–230	26–28	87.6–89.6
9	0.925	< −18	189–195	163–164	95–96
10	0.927	< −18	202–204	139–143.8	.....
11	0.995–0.999	80 to 87	79–84	13.5	.....
12	0.960–0.967	−12 turbid; −17 to −18 solid	175–183	84	.....
13	0.943–0.954	20 to 25	196–213	97.6–110.4	.....
14	ca $0.950^{25°}$	<25	196–213	98–104	.....
15	0.809–0.811	80 to 81	80.4–91.7	1.4	.....
16	0.918–0.922	24 to 34	179–206	23–40.5	95.3
17	0.926	14 to 22	253.4–262	6.2–10	82.3–90.5
18	0.964–0.974	21.5 to 27.3	192.8–195	32.8–41.7	94–95
19	0.922–0.931	−3	171–189	137–166	95.3
20	0.921–0.928	−10 to −20	187–193	111–128	93–95
21	$0.917–0.918^{\frac{25°}{25°}}$	+12 to −13	194–196	103–111.3	95.7
22	0.9188–0.923	16 to 22	195	89–103	95.9
23	0.942–0.944	−8 to −18	193–215	108–109	89.0
24	0.923–0.930	22 to 24	191–193	58–67	94.5–95.3
25	0.917–0.933	−10 to −17	171–191	94.3–135	92
26	0.917	−17 to −18	191–197	87	95.5
27	0.928–0.934	−15 to −28	190–195	145–161.7	.....
28	0.919–0.933	20 to 45	195–200	75–86	95–98
29	0.9179	15	193.3–199	64	.....
30	0.970–0.980	40.5 to 46	206.6–237.5	4.9–12.8	90–91
31	0.913–0.915	+4 to −2	193–198	62.5–79	97
32	0.934–0.938	27.1 to 29.9	195–203	47–66.5	93–95
33	$0.880^{100°}$	24 to 25	198–199	68–80	.....
34	0.930–0.938	−19 to −27	188–195	175–202	94.5–95.5
35	0.923–0.933	−5	189–192.9	148–185	.....
36	0.937–0.953	36 to 41	195–196	48–61	95.5
37	0.995	39 to 43	205.5–211.7	3.9–9.5	92–94
38	0,913–0.918	−2 to +10	193–199	57.5–75	94.8–95.9
39	0.945–0.996	40 to 44	154–178	59.3–65	.....
40	0.915–0.920	+2 turbid; −6 solid	185–196	79–88	95
41	0.924	.....	200–205	49.2–58.9	94.5–97
42	$0.866–0.873^{100°}$	20 to 24	243–255	10.5–17.5	91–91.5
43	.....	27.4	220.2–231.4	25.5–31.6	.....
44	0.918–0.925	−20	191–193	92–99.7	94–96
45	0.917–0.926	3	186–194	88–98	95
46	0.924–0.926	−16 to −18	193–195	128–141	95.4
47	0.926	−16	203.4	126.9	68.4
48	0.923–0.925	−15	188–193	121–130	96
49	0.934–0.936	22 to 24	199–203	70–99.8	99.5
50	0.913–0.917	−10	168–179	94–105	94.5–96.3
51	0.925–0.928	−13 to −18	188–203	122–141	95
52	0.915–0.926	3	187.5–196.2	130–152	93–96
53	$0.919\frac{25°}{25°}$	−4 to −16	188–193	103–117	95

CONSTANTS OF VEGETABLE AND ANIMAL

No.	Common name	Maumene' number	Acid value	Acetyl value	Refractive index at 25° C.
1	Almond	51–53	0.5–3.5	9.6	1.4593–1.4646*
2	Beef marrow	.....	1.6	.....	1.4628
3	Beef tallow	.....	0.25	2.7–8.6	.....
4	Beechnut	.....	.....	.....	1.4698
5	Beeswax	.....	16.8–20.6	15.2	1.4538–1.4566*
6	Black mustard	43	5.7–7.3	.....	1.4718
7	Bone fat	.....	.....	11.3	.....
8	Butter fat	.....	0.45–35.4	1.9–8.6	1.4555–1.4578*
9	Candlenut	.....	2	9.8	1.4760–1.4790
10	Candlenut	.....	.....	.....	1.4760–1.4790
11	Carnauba wax	.....	4–8	55.2	1.4672–1.4701*
12	Castor	46–47	0.12–0.8	146–150.5	1.4771
13	Chaulmoogra	.....	0.79–21.5	.....	1.4777–1.4779
14	Chaulmoogra	.....	.....	.....	.....
15	Chinese insect wax	.....	63	.....	.....
16	Chinese vegetable tallow	.....	2.4	.....	1.4470–1.4579*
17	Coconut	21	2.5–10.0	2.3–6.9	1.4477–1.4495*
18	Cocoa butter (Cacao)	.....	1.1–1.9	1.97	1.4537–1.4580*
19	Cod liver	102–115	5.6	1.15	1.4758–1.4783
20	Corn (maize)	81–86	1.37–2.02	7.5–11.5	1.4733
21	Cotton seed	75–90	0.6–0.9	21–25	1.4743–1.4752[15]
22	Cotton seed stearin	.....	.....	.....	.....
23	Croton	.....	27–30.9	19.8–38.6	1.4710*
24	Goose fat	.....	0.59	.....	1.4583–1.4626*
25	Grape seed	53	0.75	13.5–14.5	1.4713–1.4725
26	Hazelnut	36	.....	3.2	1.4667
27	Hemp seed	97	0.45	.....	1.4740–1.4745*
28	Horse fat	.....	0–2.44	.....	1.4618–1.4696*
29	Human fat	.....	.....	.....	1.459–1.4613*
30	Japan wax	.....	11–12	17.25–26.5	1.4560–1.4591*
31	Lard oil	41–45	1.56	.....	1.4607*
32	Lard oil (fatty tissue)	.....	0.5–0.8	2.6	1.4609–1.4620
33	Laurel (bayberry)	.....	26.3	.....	1.4783
34	Linseed	103–126	1–3.5	.....	1.4797–1.4803
35	Menhaden	123–128	5–8	.....	1.4787
36	Mutton tallow	.....	1.7–14	.....	1.4545–1.4585*
37	Myrtle wax	.....	3–4.4	.....	1.4511
38	Neat's foot	43–49	0.1–0.6	7.7–9.3	1.4643–1.4684
39	Nutmeg butter (mace)	.....	17.2	.....	1.4704
40	Olive	41.5–47	0.3–1.0	10.5	1.4657–1.4667
41	Palm	.....	10	15.7	1.4603–1.4639
42	Palm kernel	.....	5–22	7.6	1.4492–1.4543
43	Palm kernel	.....	0.33–0.55	.....	.....
44	Peach kernel	42.5	1–1.5	6.5	1.4682–1.4707
45	Peanut	45–67	0.8	3.5	1.4620–1.4653
46	Poppy seed	86–88	2.5	.....	1.4739–1.4747
47	Porpoise (body oil)	50–61	1.2	.....	1.4622–1.4627
48	Pumpkin seed	.....	.....	.....	1.4724–1.4737
49	Rabbit fat	.....	6.2–7.2	.....	1.459
50	Rape seed	51–64	0.36–1.0	14.75	1.4649–1.4659
51	Safflower	.....	0.6	16.1	1.476
52	Seal	.....	.....	.....	1.4742–1.4767
53	Sesame	65.5	9.8	.....	1.4704–1.4717
54	Soja bean (Soya, Soy)	87–88	0.3–1.8	4.9	1.4723–1.4758

OILS, FATS AND WAXES (Continued)

No.	Reichert Meissl number	Unsaponifiable matter	Insoluble fatty acids			
			Melting point °C.	Solidifying point °C.	Iodine value	Acid value
1	0.5	0.75	13–14	9.5–11.8	93.5–96.5	204
2	2.2	.....	45–46	37.9–40	55.5	204.5
3	.....	.....	42.5–44	37.9–46.2	41.3	197.2
4	.....	.....	23–24	17	114	.....
5	.....	.....	67.2	.....	.....	.....
6	.....	3.3	16–17	13.4–13.7	87–93	179.2
7	0.2–1.7	0.5–1.5	42.5–44	28	55.7–57.4	200
8	17.0–34.5	0.3–0.45	38–41	33–39	28–31	210–220
9	1.2	0.5–0.9	20–21	13	185.7	.....
10	.....	.....	.....	17.8	.....	.....
11	.....	54–55	85	.....	.....	.....
12	1.4	0.6	13	3	86.6–88.3	192.1
13	.....	.....	.....	.....	.....	.....
14	.....	.....	.....	.....	.....	.....
15	.....	.....	92.2	.....	.....	.....
16	0.2–0.9	.....	39–57	45.2–47.2; 50.9–52.5	34.2	182–208.5
17	6.6–7.5	0.2	24–27	21.2–25.2	8.4–8.8	258
18	0.3–1	.....	48–53	47.2–49.2	32.6–39	190
19	0.2	0.54–2.68	21.8–38	17.5–24.3	164–171	204–207
20	4.3	1.5–2.8	17–20	14–16	113–125	198.4
21	0.95	1.1	34.5	32–35	111–115	201.6–203.9
22	.....	.....	27–30	35.1	94	.....
23	12–13.6	0.55	.....	17–19	111–112	201
24	0.2–0.98	.....	36.6–40	31–34	65.3	202.4
25	0.46	1.6	23–25	18–20	99–132	187.4
26	0.99	0.5	22–25	19–20	87.5–90.1	200.6
27	.....	1.08	17–21	15.6–16.6	141	.....
28	1.64–2.14	.....	31.3–53.4	37.7	83.9–87.1	202.6
29	0.25–0.55	.....	35.5	30.5	64	.....
30	.....	1.1–1.6	54.5–59.6	53–56.5	.....	213.7
31	.....	0.6	33–38.4	27–33	.....	.....
32	.....	.....	37–46.6	36–42.4	.....	.....
33	1.6	.....	.....	.....	81.6–82	.....
34	0.95	0.4–1.2	20–24	16–20.6	179–209.8	196–198.8
35	1.2	0.6–1.43	.....	.....	.....	.....
36	.....	.....	33.5–49	40–48.5	34.8	198
37	0.5	.....	47–48	46	.....	230.9
38	0.9–1.2	0.12–0.65	29–41	16–26.5	62–77	201.2–206.3
39	1.1–4.2	.....	42.5	40–45	31.6	.....
40	0.6–1.5	0.4–1.0	26–30	16.9–26.4	86–90	193
41	0.9–1.9	.....	50	42.5–45.5	53.3	204–207
42	5–6.8	.....	25–28.5	20–25.5	12	251–265
43	.....	.....	.....	.....	.....	.....
44	.....	.....	10–18.9	13–13.5	94.1–101.9	205–209.9
45	0.4	0.5–0.9	.....	30.5–39	95.5–103.4	201.6
46	0.6	0.43	20.5	17–19	139	199
47	46.9	16–17	.....	.....	126	207
48	4.45	.....	26.5–29.8	26–28	.....	.....
49	0.7–2.8	.....	39–50	35–41	64.4–101.1	210–218
50	0–0.79	1.48	18.5–20	11.7–13.6	100–106	.....
51	0–0.2	.....	11–17	7–12	132.5–148.2	199
52	0.2	0.3–1.0	22–23	13–17	186.5–201.8	190.4–198
53	1.1–1.2	0.95–1.32	25–35	23–32	109–112	196–201.6
54	0.5–2.8	1.27–1.54	26.2–27.5	21.2	122	.....

CONSTANTS OF VEGETABLE AND ANIMAL

No.	Common name	Scientific name	Class†
1	Soja bean (Soya, Soy)	*Soja hispida* (*Dolichos hispida*)	V
2	Sperm	*Physeter macrocephalus*	X
3	Spermaceti	*Cetacea Oils*	XII
4	Sunflower	*Helianthus annus*	VI
5	Tung (China wood)	*Aleurites Fordii*	VI
6	Tung (China wood)	*Aleurites montana*	VI
7	Walnut	*Juglans regia*	VI
8	Whale	*Balaena mysticetus*	VII
9	White mustard seed	*Sinapis alba*	II
10	Wool fat	*Adeps lanae*	XII

† Class I, Non-drying vegetable oil of the olive oil type; Class II, non-drying vegetable oil of the rape oil type; Class III, non-drying vegetable oil of the castor oil type; Class IV, non-drying animal oil; Class V, semi-drying vegetable oil; Class VI, drying vegetable oil; Class VII, fish and marine animal oil; Class VIII, vegetable fat; Class IX, animal fat; Class X, sperm oil; Class XI, vegetable non-glyceridic wax; Class XII, animal wax.

No.	Common name	Maumene' number	Acid value	Acetyl value	Refractive index at 25° C.
1	Sperm	51	13.2	4.5–6.4	1.4573
2	Spermaceti	.....	0.5–2.8	2.6	.....
3	Sunflower	72	11.2	.....	1.4659–1.4721*
4	Tung (China wood)	.....	2	.....	1.515–1.520
5	Tung (China wood)	.....	2	.....	1.515–1.520
6	Walnut	96–110	2.5	.....	1.4770
7	Whale	85–92	1.9	11–23	1.4679–1.4724
8	White mustard seed	44–49	5.4	.....	1.4649
9	Wool fat	.....	59.8	23	1.4784–1.4822*

* Refractive index at 40° C.

OILS, FATS AND WAXES (Continued)

No.	Specific gravity at $\frac{15^\circ}{15^\circ}$ C.	Solidifying point °C.	Saponification value	Iodine value	Hehner's number
1	0.924–0.927	−10 to −16	189–193.5	122–134	93–94.5
2	0.878–0.884	15.5	120–137	80–84	.....
3	0.905–0.945	42 to 49	126–135	3.5–9.3	.....
4	0.924–0.926	−17	188–193	129–136	95
5	0.939–0.949	2 to 3	190–197	163–171	96.2
6	0.925	.....	189–195	163–164	95–96
7	0.925–0.927	−27.5	190.1–197	139–150	93.4–95.4
8	0.917–0.924	0 to −2	160–202	90–146	93–95
9	0.912–0.916	−8 to −16	171–174	94–98.4	96–97
10	0.970–0.973	.....	82–130	17–29	.....

No.	Reichert Meissl number	Unsaponifiable matter	Insoluble fatty acids			
			Melting point °C.	Solidifying point °C.	Iodine value	Acid value
1	.....	39–42	13.4	16.1	88–99	23.6
2	.....	51.5	.....	.....	.....	.....
3	0.5	0.31	22–24	18–19.8	124–134	201.6
4	1.10	0.4–0.8	40–43.8	31.2–37	145–159.4	188.8
5	0.35	0.4–0.8	.....	.....	.....	.....
6	0.92	0.5–1.0	15–20	14.3	150	.....
7	14	1–4	14–27	10–24	130.3–132	.....
8	.....	.....	15–16	9–10	94.7–110.4	181–185.8
9	8	39–44	41.8	40	17	.....

PHYSICAL AND CHEMICAL CONSTANTS OF

The following abbreviations are used: Class I, Resins; Class II, Oleo-acid; al, alcohol; bz, benzene; chl., chloroform; eth., ether; eth. acet., ethyl oil of turpentine; p. sol., partly soluble; sol., soluble; sl. sol., slightly soluble;

Name	Class	Specific Gravity	Melting Point °C.	Saponification No.	Iodine No.	Acid No.
Amber	I	1.05–1.10	250–325	85–150	62	15–35
Ammoniacum	III	1.2	.....	160–77	....	100–6
Anime (East Indian)	I	1.03	230–40	60–90	128–37	18–27
Anime (West Indian)	I	.....	.....	150–60	....	45–7
Benzoin	I	1.2	75–100	155–270	....	90–190
Canada Balsam	II	.....	.....	90–6	....	80–90
Caoutchouc	I	.....	.....	.....	71	81
Colophony	I	1.07–.09	120–50	150–200	112–7	150–80
Copaiba (Para)	II	0.9–1.0	.....	.....	....	30–68
Copaiba (Maracaibo)	II	0.9–1.0	.....	.....	....	79–91
Copaiba (Maranham)	II	0.9–1.0	.....	.....	....	72–90
Copal (Benin)	I	1.06–.08	120–66	125–150	61	100–34
Copal (Loango)	I	.....	.....	126–34	....	106–15
Copal (Sierra Leone)	I	.....	.....	146–50	....	109–14
Copal (Manilla)	I	.....	.....	178	....	128
Dammar	I	1.00–.05	95–190	20–65	....	18–60
Dragon's Blood	I	1.2	120	150–60	....	....
Elemi	....	1.02–.08	75–120	25–45	....	18–25
Galbanum	III	1.11–.13	.....	75–225	....	5–65
Guaiacum	I	1.2	85–90	.....	.....	70–80
Jalap	I	1.14–.15	150	.....	.....	12–25
Mastic	I	1.04–.07	105–20	82–92	64	50–71
Myrrh	III	1.12–.28	.....	160–200	....	59–72
Olibanum	III	1.2	.....	65–120	....	45–88
Sandarac	I	1.04	135–50	143	....	140–55
Shellac	I	1.08–.13	.....	194–213	....	48–64
Storax	I	1.12	.....	130–230	....	35–175
Tolu	II	1.1	.....	154–220	....	112–68
Turpentine (Common)	II	.....	.....	100–75	....	110–50
Turpentine (Larch)	II	1.1–1.2	.....	75–125	....	75–100

RESINS, OLEO-RESINS AND GUM-RESINS

Resins; Class III, Gum-Resins; a, acid; acet., acetone; acet. a., glacial acetic acetate; insol., insoluble; lgr., ligroin; meth. al., methyl alcohol; oil turp., w., water.

Ester No.	% Volatile at 100° C.	% Ash	Solubility
71–91	.....	0.3	p. sol. in CS_2, oil turp; sl. sol. in al., meth. al., amyl al., bz., eth; insol. in acet. a., acet., chl.
60–70	2–15	2–7	p. sol. w., al., eth.
47–62	.....	.....	
100–15	.....	0.05–.1	
30–175	4–10	0.2–3.0	sl. sol. w.; p. sol. al.
4–8	.....	.....	sol. in bz., chl., eth. acet., oil turp.; p. sol. in al., eth., lgr.
.....	.....	.....	sol. bz.; insol. acet.
7–22	0–0.5	0.02–.05	sol. in acet., al., meth. al., amyl al., bz., acet. a., chl., eth., eth. acet., CS_2, oil turp.; p. sol. in lgr.
2–18	.....	.....	sol. in bz., chl., eth., oil turp.; p. sol. al., lgr., eth. acet., CS_2; insol. w.
1–8	.....	.....	sol. chl., eth., lgr.; p. sol. in al., eth. acet., oil turp.; insol. w.
2–18	.....	.....	sol. in bz., chl., eth., oil turp.; p. sol. al., lgr., eth. acet., CS_2; insol. w.
.....	0.5–2.5	0.25–2.0	p. sol. acet. a., bz., chl., eth., oil turp.; insol. in acet., al., meth. al., lgr., CS_2.
.....	.....	.....	98.7 % sol. in eth.-al. mixture.
.....	.....	.....	92.9 % sol. in eth.-al. mixture.
.....	.....	.....	
.....	0.1–1.0	0.01–.1	sol. in bz., chl., CS_2; p. sol. in al., eth., acet., amyl al., lgr.
.....	.....	3.6	sol. in al., eth., bz.; p. sol. in chl., eth. acet., lgr.
6–26	12–20	0.02–.1	sol. in eth., chl. bz., amyl al., CS_2; sl. sol. in lgr.; p. sol. in acet. a., acet., al., meth. al., eth. acet., oil turp.
50–175	1–30	1–25	15–20 % sol. in w.; p. sol. in al.
.....	.....	1–5	p. sol. in al., bz., eth., lgr., CS_2
120–5	.....	.....	sol. in al.; p. sol. in acet. a., eth., chl.; insol. in w., bz., oil turp., CS_2
–29	0.1–1.5	0.1–.2	p. sol. in acet. a., acet., al., meth. al. chl., oil turp.; sl. sol. in CS_2; sol. in amyl al., bz., eth.; insol. w.
108–31	.....	1–8	p. sol. in w., al.
7–72	.....	.....	p. sol. in al., acet., meth. al., amyl al., chl., eth., eth. acet., oil turp.; sl. sol. in acet. a., bz.
1–33	0.05–.2	0.04–.1	sol. in acet., amyl al.; p. sol. in acet. a., al., meth. al., bz., chl., eth., lgr., CS_2; sl. sol. in oil turp.
137–63	.....	0.72–1.4	p. sol. in acet. a., meth. al., amyl al., bz., chl., eth., lgr., eth. acet., oil turp., CS_2
70–185	5–35	0–2	sol. in acet. a., al., meth. al., amyl al.; sl. sol. in acet., bz., oil turp.; insol. in eth., lgr., CS_2
25–70	.....	.....	sol in al., chl., eth. acet.; sl. sol. in w.; p. sol. in bz., eth., lgr., oil turp.
5–55	.....	.....	sol. in al., bz., chl., eth., eth. acet., oil turp.; p. sol. in lgr., CS_2
0–50	.....	.....	sol. in acet. a., al., meth. al., amyl al., bz., chl., eth., eth. acet., oil turp.; p. sol. in lgr., CS_2

PHYSICAL CONSTANTS OF COMMON MINERALS

A table giving the crystalline form, specific gravity, hardness and mean index of refraction of the common minerals. The following abbreviations of the crystal systems (in the order of symmetry) are used: reg. or isom., regular or isometric; hex., hexagonal; tetrag., tetragonal; rhomb., orthorhombic or rhombic; monocl., monoclinic; tricl., triclinic; R, radioactive mineral; amor., amorphous.

Hardness is given according to Mohs' Scale of Hardness: 1 talc, 2 gypsum, 3 calcite, 4 fluorite, 5 apatite, 6 orthoclase, 7 quartz, 8 topaz, 9 corundum, 10 diamond.

Name.	Synonym.	Formula.	Crystalline form.	Sp. Gr. $H_2O = 1$.	Hardness.	Index of refraction.
Albite	Soda feldspar	$Na_2Al_2Si_6O_{16}$	tricl.	2.61–2.64	6–6.5	1.53
Amber, fossil resin		$C_{40}H_{64}O_4$	amor.	1.0–1.1	2.0–2.5	1.55
Angelsite		$PbSO_4$	rhomb.	6.12–6.39	2.8–3.0	1.882 (β)
Anhydrite		$CaSO_4$	rhomb.	2.9–3.0	3.0–3.5	1.59
Anorthite	Lime feldspar	$Ca_2Al_4Si_4O_{16}$	tricl.	2.73–2.76	6	1.58
Apatite	Asparagus-stone	$Ca_5(Cl, F, OH)(PO_4)_3$	hex.	3.17–3.23	5	1.64
Aragonite		$CaCO_3$	rhomb.	2.9–3.0	3.5–4.0	1.63
Augite		Mg, Fe, Ca, Al silicate	monocl.	2.88–3.50	5–6	1.71
Azurite	Blue malachite, chessy copper	$2CuCO_3 \cdot Cu(OH)_2$	monocl.	3.77–3.83	3.5–4.0	1.758 (β)
Barite	Barytes, heavy spar	$BaSO_4$	rhomb.	4.3–4.6	3.0–3.5	1.64
Beryl		$Be_3Al_2Si_6O_{18}$	hex.	2.68–2.76	7.5–8.0	1.57
Biotite	Iron mica, black mica	$(H, K)_2(Mg, Fe)_2(Al, Fe)_2[SiO_4]_3$	monocl.	2.8–3.2	2.5–3.0	1.60
Bröggerite (R)	A pitchblende which contains thorium					
Calamine	Electric calamine	$H_2Zn_2SiO_5$	rhomb.	3.40–3.50	4.5–5.0	1.617 (β)
Calcite	Calcspar, Iceland spar	$CaCO_3$	hex.	2.6–2.8	3	1.60
Carnallite		$KCl \cdot MgCl_2 \cdot 6H_2O$	rhomb.	1.60	1	1.48
Carnotite (R)		$K_2O(U_2O_5)_2V_2O_5 \cdot 3H_2O$	hex.?			
Celestite	Celestine	$SrSO_4$	rhomb.	3.9–4.0	3.0–3.5	1.62
Cerrusite		$PbCO_3$	rhomb.	6.46–6.57	3.0–3.5	1.99

PHYSICAL CONSTANTS OF COMMON MINERALS (Continued)

Name.	Synonym.	Formula.	Crystalline form.	Sp. Gr. $H_2O = 1$.	Hardness.	Index of refraction.
Chalcopyrite	Copper pyrite	$CuFeS_2$	tetrag.	4.1–4.3	3–4	.....
Chalcedony	Flint, agate	SiO_2	rhomb.?	2.59–2.64	7	1.54
Clèveite (R)	A pitchblende which contains	UO_3, UO_2, Y_2O_3, E_2O_3, ThO_2, PbO, Fe_2O_3, H_2O, (He, A)	reg.	7.45	5.5	.....
Corundum	Ruby, saphire	Al_2O_3	hex.	3.9–4.0	9	1.77
Dolomite	.....	$CaMgC_2O_6$	hex.	2.85–2.95	3.5–4.5	1.62
Emery	A corundum with hematite or magnetite	.....	.....	.....	.....	.....
Fluorite	Fluorspar	CaF_2	reg.	3.1–3.2	4	1.43
Galena	Galenite	PbS	reg.	7.4–7.6	2.5	.....
Gummite (R)	.....	$(Pb, Ca, Ba)SiU_3O_{12}\cdot 5H_2O$	.....	3.9–4.5	2.5–3.0	.....
Gypsum	.....	$CaSO_4\cdot 2H_2O$	monocl.	2.2–2.4	1.5–2.0	1.52
Halite	Rock salt	$NaCl$	reg.	2.1–2.2	2	1.54
Hematite	.....	Fe_2O_3	hex.	5.19–5.28	5.5–6.5	3.08
Hornblende	.....	$Ca(Mg, Fe)_3[SiO_3]_4\cdot(Na_2, K_2, Ca, Fe, Mg)_3(Al, Fe)_2Si_3O_{12}$	monocl.	3.0–3.5	5–6	1.64
Kainite	.....	$MgSO_4\cdot KCl\cdot 3H_2O$	monocl.	2.07–2.19	2.5–3.0	.....
Kaolinite	China clay, kaolin	$H_4Al_2Si_2O_9$	monocl.	2.4–2.6	1.0–2.5	1.54
Kieserite	.....	$MgSO_4\cdot H_2O$	monocl.	2.52–2.57	3	1.55
Labradorite	Soda-lime feldspar	Intermediate between albite and anorthite	tricl.	2.70–2.72	5.0–6.0	1.563 (β)
Lepidolite	Litnium mica	$(F, OH)_2(Li, K, Na)Al_2Si_3O_9(+ Rb_2O, Cs_2O$	monocl.	2.8–2.9	2.5–3.0	1.60
Limonite	Brown iron stone, brown ocher	$2Fe_2O_3\cdot 3H_2O$	amor.	3.6–4.0	5.0–5.5	± 2.05
Magnesite	.....	$MgCO_3$	hex.	2.9–3.1	4.0–4.5	1.65
Magnetite	.....	Fe_3O_4	reg.	4.9–5.2	5.5–6.5	.....
Malachite	.....	$CuCO_3\cdot Cu(OH)_2$	monocl.	3.90–4.03	3.5–4.0	1.875 (β)
Monazite (R)	.....	$(Ce, Nd, Pr, La)PO_4(+ Th_3[PO_4]_4)$	monocl.	4.90–5.25	5.0–5.5	1.81
Muscovite	Common mica	$H_2(K, Na)Al_3Si_3O_{12}$	monocl.	2.76–3.10	2–3	1.58
Nephelite	Nepheline	$(Na_2, K_2, Ca)Al_2Si_2O_{8-n}(Na_2K, Ca)Al_2Si_2O_{10}$	hex.	2.58–2.64	5.5–6.0	1.54

PHYSICAL CONSTANTS OF COMMON MINERALS (Continued)

Name.	Synonym.	Formula.	Crystalline form.	Sp. Gr. $H_2O = 1$.	Hardness.	Index of refraction.
Olivine	.....	$Mg_2Fe_2SiO_4$	rhomb.	3.27–3.57	6.5–7.0	1.67
Orthoclase	Feldspar	$K_2Al_2Si_6O_{16}$	tricl.	2.54–2.58	6	1.52
Phlogopite	Magnesium mica, rhombic mica	$H_2(K, Na)Al_2Si_3O_{12}$(+ Mg, Fe)	rhomb.	2.78–2.85	2.5–3.0	1.606 (β)
Pitchblende (R)	U_3O_8 with oxides of Pb, Ca, Fe, Bi, Mn, Mg, Cu, Si, Al, etc. 25–80 %U; 1–6 % Th)	.....	.....	6.4–9.7	5.5	.....
Pyrite, iron	Fool's gold	FeS_2	reg.	4.9–5.2	6.0–6.5	.....
Pyrolusite	.....	MnO_2 (+ nH_2O)	?	4.7–4.9	2.0–2.5	.....
Quartz	.....	SiO_2	hex.	2.5–2.8	7	1.55
Rutile	.....	TiO_2	tetrag.	4.2–4.3	6.0–6.5	2.71
Selenite	Gypsum	.....	.....	.....	.....	.....
Sepiolite	Meerschaum	$2MgO{\cdot}3SiO_2{\cdot}2H_2O$	.....	2	2–2.5	1.54
Serpentine	.....	$H_4Mg_3Si_2O_9$	rhomb.?	2.5–2.7	3–4	1.54
Smithsonite	Dry-bone ore	$ZnCO_3$	hex.	4.30–4.45	5	1.72
Sphalerite	Zincblende	ZnS	reg.	3.9–4.2	3.5–4.0	2.37
Spinel	.....	$MgOAl_2O_3$(+ Fe, Cr)	reg.	3.52–3.71	8	1.71
Sylvite	Sylvine	KCl	reg.	1.9–2.0	2	1.43
Talc	.....	$H_2Mg_3Si_4O_{12}$	monocl.	2.69–2.80	1	1.57
Thorianite (R)	(4–10 %U, 60 %Th)	$(ThU)O_2$(+ He, Ce, La, Pb, Fe)	reg.	8.0–9.7	5–7	>1.8
Thorite (R)	(1–9 %U, 40–60 %Th)	$ThSiO_4$(+ He)	tetrag.	4.4–5.4	4	.....
Topaz	.....	(Al, O, F_2)$AlSiO_4$	rhomb.	3.40–3.65	8	1.620 (β)
Torbernite (R)	.....	$Cu(UO_2)(PO_4)_2{\cdot}8H_2O$	tetrag.	3.4–3.6	2.0–2.5	.....
Tourmaline	(H, Li, Na, K)$_9$Al$_3$[	$B{\cdot}OH]_2Si_4O_{19}$(+ Fe_2O_3, FeO, MgO, MnO)	hex.	2.94–3.24	7.0–7.5	1.65
Trögerite (R)	.....	$(UO_2)_3As_2O_8{\cdot}12H_2O$	monocl.?	3.3	.....	.....
Uraninite (R)	cryst. pitchblende	.....	.....	.....	.....	.....
Uranite lime (R)	.....	$CaO(UO_2)_2(PO_4)_2{\cdot}8H_2O$(50 %U)	rhomb.	3.05–3.19	2.0–2.5	1.57
Willemite	.....	Zn_2SiO_4	hex.	3.9–4.2	5.5	.....
Wolframite	.....	(Fe, Mn)WO_4	monocl.	7.14–7.54	5.0–5.5	.....
Wollastonite	.....	$CaSiO_3$	.....	2.7–2.9	4.5–5.0	.....
Zeunerite (R)	.....	(50 %U)$Cu(UO_2)_2(AsO_4)_2$	tetrag.	3.53	2.5	.....
Zincite	Red zinc ore	ZnO	hex.	5.43–5.70	4.0–4.5	2.02
Zircon (R)	.....	$ZrSiO_4$	tetrag.	4.0–4.7	7–8	1.95

COMPOSITION AND PHYSICAL PROPERTIES OF ALLOYS

Composition	Name	Sp. gr.	Thermal expansion coefficient	Melting-point °C.
Aluminum				
97Al, 3Cu			24×10^{-6}	640
90Al, 10Mg	Magnalium	2.50	24	608
70Al, 30Mg	Magnalium	2.09		
91Al, 9Zn		2.80		
70Al, 30Zn				600
Bismuth				
52.5Bi, 32Pb, 15.5Sn				96
50Bi, 27Pb, 13Sn, 10Cd	Lipowitz' alloy			65
50Bi, 25Pb,12.5Sn,12.5Cd	Wood's metal	9.70		65.5
50Bi, 27.1Pb, 22.9Sn	Rose metal			
40Bi, 40Pb, 20Sn	Bismuth solder			111
Copper				
90Cu, 10Al	Aluminum bronze	7.6	16.5	1050
77Cu, 15Pb, 8Sn	"B" Alloy, P.R.R.			
95Cu, 5Mn	Manganese bronze	8.8		1060
82Cu, 15Mn, 3N	Manganin	8.5		
80Cu, 20Ni	Nickeline	8.5		1190
60Cu, 40Ni	Constantan	8.4		1290
90Cu, 10Sn	Bronze, gun metal	8.8	18	1010
78Cu, 22Sn	Bell metal	8.7		890
67Cu, 33Sn	Bronze, speculum metal	8.6	18.6	750
95Cu, 4Sn, 1Zn	Bronze coins	8.96		
82Cu, 16Sn, 2Zn	Bronze bearings			
79.7Cu, 10Sn, 9.5Sb, 0.8P	Phosphor bronze	8.8		
90Cu, 10Zn	Red brass	8.60		
67Cu, 33Zn	Brass, ordinary yellow	8.40	18.5	940
60Cu, 40Zn	Muntz metal			
55Cu, 45Zn	For brazing			880
61.2Cu, 37.3Zn, 0.9Sn, 0.4 Pb, 0.2Fe	Tobin bronze			
52Cu, 26Zn, 22Ni	German silver	8.45		
60Cu, 25Zn, 15Ni	German silver		18.4	
Iridium				
95Ir, 5Pt		22.38		
Iron				
80Fe, 20Al	Ferro-aluminum	6.30		1480
97Fe, 3C	Cast iron, white	7.60		1150
94Fe, 3.5C, 2.5Si	Cast iron, gray	7.0	11.2	1230
99Fe, 1C	Steel	7.83	12.0	1430
50Fe, 50Cr	Ferro-chromium	6.9		1458
50Fe, 50Mn	Ferro-manganese			1325
86Fe, 13Mn, 1C	Manganese steel	7.81		1510
96.5Fe, 3.5Ni	Nickel steel			
74.2Fe, 25Ni, 0.8C	Ferro-nickel	8.1	18	1500
67.8Fe, 32Ni, 0.2C	Ferro-nickel, valve steel	8.0	4	1480
63.8Fe, 36Ni, 0.2C	Invar	8.0	0.8	1497
53.85Fe, 46Ni, 0.15C	Platinite	8.2	7.5	1470
95.1Fe, 3Ni, 1.5Cr. 0.4C	Nickel-chrome steel			
97.6Fe, 2Si, 0.4C	Silicon steel			
94.5Fe, 5W, 0.5C	Tungsten steel			
75Fe, 18W, 6Cr, 0.3Va, 0.7C	High speed steel			
Gold				
90Au, 10Cu	Coinage	17.17		940
84Au, 16Cu	Jewelry			
75Au, 24Cu	Jewelry			

COMPOSITION AND PHYSICAL PROPERTIES OF ALLOYS (Continued)

Composition.	Name.	Specific gravity.	Thermal expansion coefficient.	Melting point °C.
Lead				
90Pb, 10Sb	Magnolia	.....	.....	.....
85Pb, 15Sb	.....	10.4	19.5	230
82Pb, 15Sb, 3Sn	Type metal	.....	.....	.....
67Pb, 33Sn	Solder	9.4	25.0	240
75Pb, 5Sn, 19Sb, 1Cu	White metal	9.5	.....	238
84.33Pb, 14.38Sb, 0.61Fe, 0.68Zn	Carbox metal	.....	.....	.....
Mercury				
80Hg, 20Bi	Bismuth amalgam	.....	.....	.....
70Hg, 30Cu	Dentists' amalgam	.....	.....	.....
Nickel				
60Ni, 33Cu, 6.5Fe	Monel metal	8.90	14	1360
Platinum				
90Pt, 10Ir	Platinum-iridium	21.61	8.8	.....
90Pt, 10Rh	Platinum-rhodium	.....	.....	.....
Silver				
90Ag, 10Cu	Coinage	10.3	.....	875
80Ag, 20Cu	Jewelry	.....	.....	.....
Tin				
90Sn, 10Sb	Britannia	.....	.....	260
80Sn, 20Sb	.....	.....	.....	.....
90Sn, 7Sb, 3Cu	Babbitt	.....	.....	.....
75Sn, 12.5Sb, 12.5Cu	Antifriction	7.53	.....	233
97Sn, 3Cu	Rhine metal	7.35	.....	300
68Sn, 32Cd	.....	7.70	.....	.....
82Sn, 12Sb, 6Cu	White metal	.....	.....	.....
Zinc				
95Zn, 5Al	.....	6.80	.....	.....

COMMON NAMES OF CHEMICALS, THEIR CORRECT CHEMICAL NAMES AND FORMULÆ

Common Name	Chemical Name	Formula
Aldehyde	Acetaldehyde	CH_3CHO
Alum, Alum flour, Alum meal	Generally refers to potassium aluminum sulfate	$K_2Al_2(SO_4)_4 \cdot 24H_2O$
Alumina	Aluminum oxide	Al_2O_3
Amidol	Diaminophenol hydrochloride	$C_6H_3(NH_2)_2OH \cdot 2HCl$
Antichlor	Sodium thiosulfate	$Na_2S_2O_3 \cdot 5H_2O$
Antifebrin	Acetanilide	$C_6H_5NHCOCH_3$
Antimony bloom	Antimony trioxide	Sb_2O_3
Antimony black, Antimony glance, Antimony red	Antimony trisulfide	Sb_2S_3
Antimony vermilion	Antimonous oxysulfide	$Sb_2S_3 + Sb_2O_3$
Aqua fortis	Nitric acid	HNO_3
Aqua regia	Nitric acid + hydrochloric acid	$HNO_3 + 3HCl$
Arsenic glass	Arsenious oxide	As_2O_3
Aspirin	Acetyl-salicylic acid	$C_6H_4\begin{matrix}OCOCH_3\\COOH\end{matrix}$
Baking soda	Sodium bicarbonate	$NaHCO_3$
Baryta	Barium oxide	BaO
Barytes	Barium sulfate	$BaSO_4$
Benzol	Benzene	C_6H_6
Bitter salt	Magnesium sulfate	$MgSO_4 \cdot 7H_2O$
Black ash	Impure sodium carbonate	.....
Blanc-fixe	Barium sulfate	$BaSO_4$
Bleaching powder	Calcium hypochlorite	$CaOCl_2$
Blue copperas, Blue stone, Blue vitriol	Copper sulfate	$CuSO_4 \cdot 5H_2O$
Blue salts	Nickel sulfate	$NiSO_4 \cdot 7H_2O$
Bone ash	Impure calcium phosphate	.....
Boracic acid	Boric acid	H_3BO_3
Borax	Sodium tetraborate	$Na_2B_4O_7 \cdot 10H_2O$
Brimstone	Sulfur	.....
Burnt alum	Anhydrous potassium aluminum sulfate	$K_2Al_2(SO_4)_4$
Burnt lime	Calcium oxide	CaO
"Butter of"	Refers to the chloride.	
Cadmium yellow	Cadmium sulfide	CdS
Calomel	Mercurous chloride	$HgCl$
Cane sugar	Sucrose	$C_{12}H_{22}O_{11}$
Carbolic acid	Phenol	C_6H_5OH
Carbonic anhydride	Carbon dioxide	CO_2
Carborundum	Silicon carbide	SiC
"Caustic" refers to the hydroxide of a metal.		
Chalk	Calcium carbonate	$CaCO_3$
Chili niter, Chili saltpeter	Sodium nitrate	$NaNO_3$
Chrome alum	Potassium chromium sulfate	$K_2Cr_2(SO_4)_4 \cdot 24H_2O$
Chrome green	Chromium oxide	Cr_2O_3
Chrome yellow	Lead chromate	$PbCrO_4$
Chromic acid	Chromium trioxide	CrO_3
Cobalt black	Cobalt oxide	CoO
Common salt	Sodium chloride	$NaCl$
Copperas	Ferrous sulfate	$FeSO_4 \cdot 7H_2O$

COMMON NAMES OF CHEMICALS, THEIR CORRECT CHEMICAL NAMES AND FORMULÆ (Continued)

Common Name	Chemical Name	Formula
Corn sugar	Glucose	$C_6H_{12}O_6 \cdot H_2O$
Corrosive sublimate	Mercuric chloride	$HgCl_2$
Corundum	Aluminum oxide	Al_2O_3
Cream of tartar	Potassium acid tartrate	$KHC_4H_4O_6$
Cresylic acid	Mixture of the three cresols.	$C_6H_4(CH_3)OH$
Derinatol	Basic bismuth gallate	$Bi(OH)_2C_7H_5O_5$
Dextrose	Glucose	$C_6H_{12}O_6 \cdot H_2O$
Epsom salts	Magnesium sulfate	$MgSO_4 \cdot 7H_2O$
"Flowers of" a metal is a	synonym for the oxide.	
Fluorspar	Calcium fluoride	CaF_2
Formalin	Forty per cent solution of formaldehyde in water	
Fruit sugar	Fructose	$C_6H_{12}O_6$
Glauber's salt	Sodium sulfate	$Na_2SO_4 \cdot 10H_2O$
Grain alcohol	Ethyl alcohol	C_2H_5OH
Grape sugar	Glucose	$C_6H_{12}O_6 \cdot H_2O$
Green vitriol	Ferrous sulfate	$FeSO_4 \cdot 7H_2O$
Gypsum	Calcium sulfate	$CaSO_4 \cdot 2H_2O$
Hypo	Sodium thiosulfate	$Na_2S_2O_3 \cdot 5H_2O$
King's yellow	Arsenious sulfide	As_2S_3
Laughing gas	Nitrous oxide	N_2O
Lemon chrome	Barium chromate	$BaCrO_4$
Levulose	Fructose	$C_6H_{12}O_6$
Lime	Calcium oxide	CaO
Litharge	Lead monoxide	PbO
Lithopone	Zinc sulfide + barium sulfate	$ZnS + BaSO_4$
Lunar caustic	Silver nitrate	$AgNO_3$
Magnesia	Magnesium oxide	MgO
Marble	Calcium carbonate	$CaCO_3$
Metol	Monomethylpara-amido-metacresol sulfate or chloride	$(C_6H_3(OH)CH_3 NHCH_3)_2 \cdot H_2SO_4$
Microcosmic salt	Sodium ammonium hydrogen phosphate	$Na(NH_4)HPO_4 \cdot 4H_2O$
Milk of barium	Barium hydroxide	$Ba(OH)_2 \cdot 8H_2O$
Milk of magnesium	Magnesium hydroxide	$Mg(OH)_2$
Milk sugar	Lactose	$C_{12}H_{22}O_{11} \cdot H_2O$
Minium	Lead tetroxide	Pb_3O_4
Mohr's salt	Ferrous ammonium sulfate	$Fe(NH_4)_2(SO_4)_2 \cdot 6H_2O$
"Muriate of" a metal is syn	onymous with the chloride.	
Muriatic acid	Hydrochloric acid	HCl
Niter	Potassium nitrate	KNO_3
Nordhausen acid	Fuming sulfuric acid	$H_2SO_4 + SO_3$
Oil of almond, artificial	Benzaldehyde	C_6H_5CHO
Oil of mirbane	Nitrobenzene	$C_6H_5NO_2$
Oil of mustard, artificial	Allyl isothiocyanate	C_3H_5SCN
Oil of vitriol	Sulfuric acid	H_2SO_4
Oil of wintergreen, artificial	Methyl salicylate	$C_8H_8O_3$
Pearl ash	Potassium carbonate	K_2CO_3
Permanent white	Barium sulfate	$BaSO_4$
Phosgene	Carbonyl chloride	$COCl_2$
Plaster of Paris	Calcium sulfate	$2CaSO_4 + 1H_2O$
Plumbago	Graphite	
Precipitated chalk	Calcium carbonate	$CaCO_3$
Prussian blue	Ferric ferrocyanide	$Fe_4(Fe(CN)_6)_3$
Prussic acid	Hydrocyanic acid	HCN

COMMON NAMES OF CHEMICALS, THEIR CORRECT CHEMICAL NAMES AND FORMULÆ (Continued)

Common Name	Chemical Name	Formula
Pyrolusite	Manganese dioxide	MnO_2
Quick lime	Calcium oxide	CaO
Quinol	Hydroquinone	$C_6H_4(OH)_2(1.4)$
Realgar	Arsenic disulfide	As_2S_2
Red lead	Lead tetroxide	Pb_3O_4
Red prussiate of potash	Potassium ferricyanide	$K_3Fe(CN)_6$
Rochelle salt	Potassium sodium tartrate	$KNaC_4H_4O_6 \cdot 4H_2O$
Sal ammoniac	Ammonium chloride	NH_4Cl
Sal soda	Sodium carbonate	$Na_2CO_3 \cdot 10H_2O$
Salol	Phenyl salicylate	$C_6H_4\langle^{OH(1)}_{COOC_6H_5(2)}$
Salt	Sodium chloride	$NaCl$
Salt cake	Impure sodium sulfate	
Salt of lemon Salt of sorrel Salt of tartar	Potassium acid oxalate	$KHC_2O_4 \cdot H_2O$
Salt of wormwood	Potassium carbonate	K_2CO_3
Salt peter	Potassium nitrate	KNO_3
Scheele's green	Copper hydrogen arsenite	$CuHAsO_3$
Silica	Silicon dioxide	SiO_2
Slaked lime	Calcium hydroxide	$Ca(OH)_2$
Soda	Sodium carbonate	$Na_2CO_3 \cdot 10H_2O$
Sodium hyposulfite	Sodium thiosulfate	$Na_2S_2O_3 \cdot 5H_2O$
Soluble glass	Sodium silicate	$Na_2SiO_3 + H_2O$
Soluble tartar	Potassium tartrate	$2K_2C_4H_4O_6 + 1H_2O$
Sulfuric ether	Diethyl ether	$(C_2H_5)_2O$
Sugar of lead	Lead acetate	$Pb(CH_3CO_2)_2 \cdot 3H_2O$
Sugar of milk	Lactose	$C_{12}H_{22}O_{11} \cdot 1H_2O$
Table salt	Sodium chloride	$NaCl$
Tartar emetic	Potassium antimonyl tartrate	$2K(SbO)C_4H_4O_6 \cdot 1H_2O$
T. N. T.	Trinitro toluene	$C_6H_2(CH_3)(NO_2)_3$ (1, 2, 4, 6)
Turnbull's blue	Ferrous ferricyanide	$Fe_3(Fe(CN)_6)_2$
Ultramarine yellow	Barium chromate	$BaCrO_4$
Unslaked lime	Calcium oxide	CaO
Venetian red	Ferric oxide	Fe_2O_3
Verdigris	Basic copper acetate	$2Cu(C_2H_3O_2)_2 + CuO(?)$
Vermilion	Red mercuric sulfide	HgS
"Vitriolate of" a metal is	synonymous with the sulfate.	
Washing soda	Sodium carbonate	$Na_2CO_3 \cdot 10H_2O$
Water glass	Sodium silicates dissolved in water	
White lead	Basic lead carbonate	$2PbCO_3 + Pb(OH)_2$
White vitriol	Zinc sulfate	$ZnSO_4 \cdot 7H_2O$
Whiting	Calcium carbonate	$CaCO_3$
Wood alcohol	Methyl alcohol	CH_3OH
Yellow prussiate of potash	Potassium ferrocyanide	$K_4Fe(CN)_6 \cdot 3H_2O$
Zinc white	Zinc oxide	ZnO
Zinc vitriol	Zinc sulfate	$ZnSO_4 \cdot 7H_2O$

TRADE NAMES OF DYESTUFF INTERMEDIATES

Trade Name	Chemical Name
A acid	1, 7-Dihydroxy-3, 6-disulfonic acid
Alizarin	1, 2-dihydroxyanthraquinone
Amino-G acid	2-Naphthylamine-6, 8-disulfonic acid
Amino-R acid	2-Naphthylamine-3, 6-disulfonic acid
Andresen's acid	1-Naphthol-3, 8-disulfonic acid
Anisidine	o-Aminophenol methyl ether
Anthrachrysone	1, 3, 5, 7-Tetrahydroxyanthraquinone
Anthraflavic acid	2, 6-Dihydroxyanthraquinone
Anthranilic acid	o-Aminobenzoic acid
Anthrarufin	1, 5-Dihydroxyanthraquinone
Armstrong's acid	Naphthalene-1, 5-disulfonic acid
Badische acid	2-Naphthylamine-8-sulfonic acid
Bayer's acid	2-Naphthol-8-sulfonic acid
Benzidine	p, p′ -Diamino-diphenyl
Brönner's acid	2-Naphthylamine-6-sulfonic acid
β acid	Anthraquinone-2-sulfonic acid
Chromotrope acid	1, 8-Dihydroxynaphthalene-3, 6-disulfonic acid
Chrysazin	1, 8-Dihydroxyanthraquinone
Cleve's acids	1-Naphthylamine-6- and -7-sulfonic acids
Cleve's acid	1-Naphthylamine-5-sulfonic acid
Cleve's acid	1-Naphthylamine-6-sulfonic acid
Cleve's acid	1-Naphthylamine-3-sulfonic acid
Cleve's acid	1-Naphthylamine-7-sulfonic acid
Cresotic acids	Cresol carboxylic acids
Croceine acid	2-Naphthol-8-sulfonic acid
Dahl's acid	2-Naphthylamine-5-sulfonic acid
Dahl's acid II	1-Naphthylamine-4, 6-disulfonic acid
Dahl's acid III	1-Naphthylamine-4, 7-disulfonic acid
Disulpho acid S	1-Naphthylamine-4, 8-disulfonic acid
DTS	Dehydrothio-p-toluidine sulfonic acid
δ acid	1-Naphthol-4, 8-disulfonic acid 1-Naphthylamine-4, 8-disulfonic acid
Ebert and Merz's acid	Naphthalene-2, 7-disulfonic acid
Ebert and Merz's acid	Naphthalene-2, 6-disulfonic acid
Ewer and Pick's acid	Naphthalene-1, 6-disulfonic acid
ϵ acid	1-Naphthol-3, 8-disulfonic acid 1-Naphthylamine-3, 8-disulfonic acid
F acid	2-Naphthol-7-sulfonic acid
Freund's acid	1-Naphthylamine-3, 6-disulfonic acid
G acid	2-Naphthol-6, 8-disulfonic acid
Gallic acid	3, 4, 5-Trihydroxybenzoic acid
γ-acid	2-Amino-8-naphthol-6-sulfonic acid
H acid	1-Amino-8-naphthol-3, 6-disulfonic acid
Histazarin	2, 3-Dihydroxyanthraquinone
Isoanthraflavic acid	2, 7-Dihydroxyanthraquinone
J acid	2-Amino-5-naphthol-7-sulfonic acid
K acid	1-Amino-8-naphthol-4, 6-disulfonic acid
Kalle's acid	1-Naphthylamine-2, 7-disulfonic acid
Ketone base	Tetramethyldiaminobenzophenone
Koch's acid	1-Naphthylamine-3, 6, 8-trisulfonic acid
L acid	1-Naphthol-5-sulfonic acid
Laurent's acid	1-Naphthylamine-5-sulfonic acid
Lepidine	4-Methylquinoline
Leucotrope	Phenyldimethylbenzylammonium chloride
M acid	1-Amino-5-naphthol-7-sulfonic acid
Mesidine	2, 4, 6-Trimethylaniline
Metanilic acid	Aniline-m-sulfonic acid
Michler's ketone	Tetramethyldiaminobenzophenone
Naphthazarin	5, 6-Dihydroxy-1, 4-naphthoquinone
Naphthionic acid	1-Naphthylamine-4-sulfonic acid
o-Naphthionic	1-Naphthylamine-2-sulfonic acid
Naphthol A. S.	Anilide of -hydroxynaphthoic acid

TRADE NAMES OF DYESTUFF INTERMEDIATES
(Continued)

Trade Name	Chemical Name
Naphthoresorcin	1, 3-Dihydroxynaphthalene
Nevile and Winther's acid	1-Naphthol-4-sulfonic acid
Nigrotic acid	1, 7, 3, 6-Dihydroxysulfonaphthoic acid
Nitroso base	p-Nitrosodimethylaniline
NW acid	Nevile and Winther's acid
Peri acid	1-Naphthylamine-8-sulfonic acid
p-Phenetidine	p-Aminophenol ethyl ether
Phenyl-gamma acid	2-Phenylamino-8-naphthol-6-sulfonic acid
Phenyl Peri acid	Phenyl-1-naphthylamine-8-sulfonic acid
Phosgene	Carbonyl chloride
Phthalic acid	o-Benzenedicarboxylic acid
Picramic acid	2-Amino-4, 6-dinitrophenol
Picric acid	2, 4, 6-Trinitrophenol
Primuline base	p-Toluidine heated with sulfur.
Purpurin	1, 2, 4-Trihydroxyanthraquinone
Pyrogallol	1, 2, 3-Trihydroxybenzene
Quinaldine	2-Methylquinoline
Quinazarin	1, 4-Dihydroxyanthraquinone
R acid	2-Naphthol-3, 6-disulfonic acid
2 R acid	2-Amino-8-naphthol-3, 6-disulfonic acid
Red acid	1, 5-Dihydroxynaphthalene-3, 7-disulfonic acid
RG acid	1-Naphthol-3, 6-disulfonic acid
Resorcinol	1, 3-Dihydroxybenzene
S acid	1-Amino-8-naphthol-4-sulfonic acid
2 S acid	1-Amino-8-naphthol-2, 4-disulfonic acid
Salicylic acid	o-Hydroxybenzoic acid
Schäffer's acid	2-Naphthol-6-sulfonic acid
Schollkopf's acid	1-Naphthol-4, 8-disulfonic acid 1-Naphthylamine-4, 8-disulfonic acid 1-Naphthylamine-8-sulfonic acid
Sulfanilic acid	Aniline-p-sulfonic acid
Thiocarbanilide	Diphenylthiourea
Tobias acid	2-Naphthylamine-1-sulfonic acid
Tolidine	Di-p-aminoditolyl
Toluidine	Amino toluene
Xylidine	Amino xylene
Yellow acid	1, 3-Dihydroxynaphthalene-5, 7-disulfonic acid

PERIODIC ARRANGEMENT OF THE ELEMENTS

SERIES	PERIOD	ZERO GROUP	GROUP I — R_2O	GROUP II — RO	GROUP III — R_2O_3	GROUP IV RH_4 RO_2
0						
1			Hydrogen H = 1.008 No. 1			
2	1	Helium He = 4.00 No. 2	Lithium Li = 6.940 No. 3	Beryllium Be = 9.02 No. 4	Boron B = 10.82 No. 5	Carbon C = 12.000 No. 6
3	2	Neon Ne = 10.2 No. 10	Sodium Na = 22.997 No. 11	Magnesium Mg = 24.32 No. 12	Aluminum Al = 26.97 No. 13	Silicon Si = 28.06 No. 14
4	3	Argon A = 39.91 No. 18	Potassium K = 39.096 No. 19	Calcium Ca = 40.07 No. 20	Scandium Sc = 45.10 No. 21	Titanium Ti = 48.1 No. 22
5			Copper Cu = 63.57 No. 29	Zinc Zn = 65.38 No. 30	Gallium Ga = 69.72 No. 31	Germanium Ge = 72.60 No. 32
6	4	Krypton Kr = 82.9 No. 36	Rubidium Rb = 85.44 No. 37	Strontium Sr = 87.63 No. 38	Yttrium Y = 88.9 No. 39	Zirconium Zr = 91 No. 40
7			Silver Ag = 107.880 No. 47	Cadmium Cd = 112.41 No. 48	Indium In = 114.8 No. 49	Tin Sn = 118.70 No. 50
8	5	Xenon Xe = 130.2 No. 54	Caesium Cs = 132.81 No. 55	Barium Ba = 137.37 No. 56	Lanthanum La = 138.90 No. 57	Cerium Ce = 140.25 No. 58
9						
10	6					
11			Gold Au = 197.2 No. 79	Mercury Hg = 200.61 No. 80	Thallium Tl = 204.39 No. 81	Lead Pb = 207.20 No. 82
12	7	Radon Rn = 222 No. 86	No. 87	Radium Ra = 225.95 No. 88	No. 89	Thorium Th = 232.15 No. 90

Elements not classified in the table above:

Praseodymium Pr = 140.92 No. 59	Neodymium Nd = 144.27 No. 60	Illinium Il = 146(?) No. 61	Samarium Sm = 150.43 No. 62	Europium Eu = 152.0 No. 63
	Gadolinium Gd = 157.26 No. 64	Terbium Tb = 159.2 No. 65	Dysprosium Dy = 162.52 No. 66	

MENDELEJEFF'S (REVISED TO 1925)

GROUP V RH_3 R_2O_5	GROUP VI RH_2 RO_3	GROUP VII RH R_2O_7	GROUP VIII		
Nitrogen N = 14.008 No. 7	Oxygen O = 16.000 No. 8	Fluorine F = 19.00 No. 9			
Phosphorus P = 31.027 No. 15	Sulfur S = 32.064 No. 16	Chlorine Cl = 35.457 No. 17			
Vanadium V = 50.96 No. 23	Chromium Cr = 52.01 No. 24	Manganese Mn = 54.93 No. 25	Iron Fe = 55.84 No. 26	Cobalt Co = 58.94 No. 27	Nickel Ni = 58.69 No. 28
Arsenic As = 74.96 No. 33	Selenium Se = 79.2 No. 34	Bromine Br = 79.916 No. 35			
Columbium Cb = 93.1 No. 41	Molybdenum Mo = 96.0 No. 42	No. 43	Ruthenium Ru = 101.7 No. 44	Rhodium Rh = 102.91 No. 45	Palladium Pd = 106.7 No. 46
Antimony Sb = 121.77 No. 51	Tellurium Te = 127.5 No. 52	Iodine I = 126.932 No. 53			
Tantalum Ta = 181.5 No. 73	Tungsten W = 184.0 No. 74	No. 75	Osmium Os = 190.8 No. 76	Iridium Ir = 193.1 No. 77	Platinum Pt = 195.23 No. 78
Bismuth Bi = 209.00 No. 83	No. 84				
No. 91	Uranium U = 238.17 No. 92	No. 93			

Holmium Ho = 163.4 No. 67	Erbium Er = 167.7 No. 68	Thulium Tm = 169.4 No. 69	Ytterbium Yb = 173.6 No. 70	Lutecium Lu = 175.0 No. 71	Hafnium (Celtium) Hf. = 180.8 No. 72
	Masurium Ma = No. 43		Rhenium Re = No. 75		

QUALITATIVE ANALYSIS SCHEME

(From A. A. Noyes' Qualitative Analysis, published by the Macmillan Co., N. Y., by permission)

Basic Constituents

Separation of the Basic Constituents into Groups

Solution in dilute nitric acid containing all the common basic constituents. Add NH_4Cl.

<table>
<tr><td rowspan="2">Precipitate: Silver-Group (Pb, Ag, Hg), as chlorides.*</td><td colspan="4">Filtrate Saturate with H_2S gas.</td></tr>
<tr><td colspan="2">Precipitate: Copper-Group and Tin-Group as sulfides. Treat with Na_2S–Na_2S_2 solution.</td><td colspan="2">Filtrate: Add NH_4OH and $(NH_4)_2S$.</td></tr>
<tr><td>Residue: Copper-Group (Pb, Bi, Cu, Cd), as sulfides.</td><td>Solution: Tin-Group (Hg, As, Sb, Sn), as sodium sulfo-salts.</td><td colspan="2">Precipitate: Aluminum-Group and Iron-Group, as hydroxides and sulfides. Dissolve in acid, add NaOH and Na_2O_2.</td><td colspan="2">Filtrate †: Add $(NH_4)_2CO_3$.</td></tr>
<tr><td></td><td></td><td>Filtrate: Aluminum-Group (Al, Zn, Cr), as sodium salts.</td><td>Precipitate: Iron-Group (Mn, Fe, Co, Ni), as hydroxides.</td><td>Precipitate: Alkaline-Earth Group (Ba, Sr, Ca, Mg), as carbonates.</td><td>Filtrate: Alkali-Group (NH_4, K, Na), as nitrates and chlorides.</td></tr>
</table>

* Lead is precipitated with the silver-group only when a large quantity is present, and then only partially; mercury is precipitated only when it is in the mercurous state.

† Evaporate filtrate to 10 cc., cool, filter, add 15 cc. 95% alcohol and 15 cc. n$(NH_4)_2CO_3$.

QUALITATIVE ANALYSIS SCHEME (Continued)

Analysis of the Silver-Group

Precipitate: $PbCl_2$, AgCl, Hg_2Cl_2. Treat with hot water.

Solution: $PbCl_2$. Add K_2CrO_4.

Precipitate: $PbCrO_4$.

Residue: AgCl, Hg_2Cl_2. Pour NH_4OH through the filter.

Black residue: Hg and $Hg\begin{matrix}Cl\\NH_2\end{matrix}$.

Solution: $Ag(NH_3)_2Cl$. Add HNO_3.

Precipitate: AgCl.

Separation of the Copper and Tin Groups

Hydrogen Sulfide Precipitate: PbS, Bi_2S_3, CuS, CdS. HgS, As_2S_3, As_2S_5, Sb_2S_3, Sb_2S_5, SnS, SnS_2. Treat with Na_2S–Na_2S_2 solution.

Residue: PbS, Bi_2S_3, CuS, CdS.

Solution: Na_2HgS_2, Na_3AsS_4, Na_3SbS_4, Na_2SnS_3. Acidify with HCl.

Precipitate: HgS, As_2S_5, Sb_2S_5, SnS_2, S.

Filtrate: NaCl. Reject.

Analysis of the Copper-Group

Residue from the Sodium Sulfide Treatment: PbS, Bi_2S_3, CuS, CdS. Boil with HNO_3.

Solution: Pb, Bi, Cu, Cd as nitrates. Add H_2SO_4, evaporate, add water.

Precipitate: $PbSO_4$. Dissolve in NH_4Ac, add K_2CrO_4.

Yellow precipitate: $PbCrO_4$.

Filtrate. Add NH_4OH.

Precipitate: $Bi(OH)_3$. Add Na_2SnO_2.

Black residue: Bi.

Filtrate: $Cu(NH_3)_4SO_4$, $Cd(NH_3)_4SO_4$.

To a small part add HAc and $K_4Fe(CN)_6$.

Red precipitate: $Cu_2Fe(CN)_6$.
White precipitate: $Cd_2Fe(CN)_6$.

To the remainder add H_2SO_4 and Fe.

Precipitate: Cu.

Solution: $CdSO_4$. Add H_2S.

Yellow precipitate: CdS.

QUALITATIVE ANALYSIS SCHEME (Continued)

Analysis of the Tin-Group

Precipitate from Sodium Sulfide Solution: S, HgS, As_2S_5, Sb_2S_5, SnS_2. Heat with 12 n. HCl.

Residue: S, HgS, As_2S_5. Add NH_4OH.		Solution: $SbCl_3$. H_2SnCl_6. Dilute, heat, pass in H_2S.	
Residue: S, HgS. Add HCl and $KClO_3$.	Solution. Evaporate, add HNO_3, then NH_4OH	Orange precipitate: Sb_2S_3. Dissolve in HCl, add Sn.	Solution: H_2SnCl_6. Partly neutralize, pass in H_2S
Solution: $HgCl_2$. Add $SnCl_2$.	Solution: $(NH_4)_3AsO_4$. Add $Mg(NO_3)_2$.	Black deposit: Sb. Add NaOBr.	Precipitate: SnS_2. Evaporate without filtering.
Precipitate: Hg_2Cl_2 or Hg.	Precipitate: $MgNH_4AsO_4$. Add $AgNO_3$.	Black deposit: Sb.	Solution: H_2SnCl_6. Boil with Sb.
	Red residue: Ag_3AsO_4.		Solution: $SnCl_2$. Add $HgCl_2$.
			Precipitate: Hg_2Cl_2.

Separation of the Aluminum and Iron Groups

Filtrate from the Hydrogen Sulfide Precipitate. Add NH_4OH in excess.

Precipitate *: $Al(OH)_3$, $Cr(OH)_3$, $Fe(OH)_{2-3}$; $Mn(OH)_3$ after exposure to air.
Solution: Salts of $Zn(NH_3)_4$, $Ni(NH_3)_4$, Co, Mn, Ba, Sr, Ca, Mg, K, and Na. Add $(NH_4)_2S$ and filter.

Precipitate *: $Al(OH)_3$, $Cr(OH)_3$, FeS, ZnS, MnS, CoS, NiS. Dissolve in HCl and $KClO_3$, add NaOH.	Filtrate: Alkaline-Earth and Alkali Groups.
Precipitate *: $Fe(OH)_3$, $Mn(OH)_2$, $Co(OH)_2$, $Ni(OH)_2$. Solution: $NaAlO_2$, $NaCrO_2$, Na_2ZnO_2. Add Na_2O_2 and filter.	
Filtrate: Aluminum-Group. $NaAlO_2$, Na_2ZnO_2, Na_2CrO_4.	Precipitate *: Iron-Group. $MnO(OH)_2$, $Fe(OH)_3$, $Co(OH)_3$, $Ni(OH)_2$.

* When phosphate is present in the solution, these precipitates may contain the phosphates of the elements otherwise precipitated as hydroxides, and also the phosphates of barium, strontium, calcium, and magnesium.

QUALITATIVE ANALYSIS SCHEME (Continued)

Analysis of the Aluminum-Group

Filtrate from the Sodium Hydroxide and Peroxide Treatment: $NaAlO_2$, Na_2ZnO_2, Na_2CrO_4. Acidify with HCl, add NH_4OH.

Precipitate: $Al(OH)_3$. Dissolve in HNO_3, add $Co(NO_3)_2$, evaporate, ignite.	Filtrate: $Zn(NH_3)_4Cl_2$, Na_2CrO_4. Add Na_2CO_3, boil to expel NH_3.	
Blue residue: $Co(AlO_2)_2$.	Precipitate: $ZnCO_3xZn(OH)_2$. Dissolve in HCl, add NH_4OH and $(NH_4)_2S$.	Filtrate: Na_2CrO_4. Add HAc and $PbAc_2$.
	White precipitate: ZnS.	Yellow precipitate: $PbCrO_4$.

Analysis of the Iron-Group

Precipitate Produced by Sodium Hydroxide and Peroxide:
A. Phosphate absent: $MnO(OH)_2$, $Fe(OH)_3$,* $Zn(OH)_2$, $Co(OH)_3$, $Ni(OH)_2$.
B. Phosphate present: Also $FePO_4$, and alkaline-earth phosphates and carbonates.
Heat with HNO_3 and $KClO_3$.

Precipitate: MnO_2. Add HNO_3 and H_2O_2.	Solution: A. $Fe(NO_3)_3$, $Zn(NO_3)_2$, $Co(NO_3)_2$, $Ni(NO_3)_2$. Add NH_4OH (P. 63). B. Also $Ba(NO_3)_2$, etc., and H_3PO_4. Nearly neutralize with NH_4OH, add NH_4Ac and $Fe(NO_3)_3$, dilute, and boil.†		
Solution: $Mn(NO_3)_2$. Add BiO_3.	Precipitate: A. $Fe(OH)_3$ B. Also $FePO_4$.	Filtrate. Add NH_4OH, pass in H_2S.	
Purple color: $HMnO_4$.		Precipitate: ZnS, CoS, NiS.	Filtrate: A. NH_4 salts. Reject. B. Ba, Ca, Sr, Mg, and NH_4 salts.

* All the zinc may be carried into this precipitate by elements of the iron-group when they are present in large quantity.
† First testing a small portion of the solution for iron with $K_4Fe(CN)_6$.

QUALITATIVE ANALYSIS SCHEME (Continued)

Separation of Zinc, Nickel and Cobalt

Hydrogen Sulphide Precipitate: ZnS, CoS, NiS. Treat with cold I n. HCl.

Solution: $ZnCl_2$, $CoCl_2$*, $NiCl_2$*. Add NaOH and Na_2O_2.

Residue: CoS, NiS.

Filtrate: Na_2ZnO_2. Add $(NH_4)_2S$.

Precipitate: $Co(OH)_2$, $Ni(OH)_2$.

White precipitate: ZnS. Dissolve in HNO_3, add $Co(NO_3)_2$ and Na_2CO_3, ignite.

Green residue: $CoZnO_2$.

Add HCl and $KClO_3$.

Solution: $CoCl_2$, $NiCl_2$. Evaporate, add HAc and KNO_2.

Yellow precipitate: $K_3Co(NO_2)_6$.

Filtrate: $NiCl_2$. Add $(CH_3)_2C_2(NOH)_2$.

Red precipitate: $[(CH_3)_2C_2(NOH)NO]_2Ni$.

* A small proportion of the cobalt and nickel present always dissolves in the dilute HCl.

Analysis of the Alkaline-Earth Group

Ammonium Carbonate Precipitate: $BaCO_3$, $SrCO_3$, $CaCO_3$, $MgCO_3 \cdot (NH_4)_2CO_3$. Dissolve in HAc, add NH_4Ac and K_2CrO_4.

Precipitate: $BaCrO_4$. Dissolve in HCl, evaporate, add HAc, NH_4Ac, and K_2CrO_4.

Precipitate: $BaCrO_4$.

Filtrate. Add NH_4OH and C_2H_5OH.

Precipitate: $SrCrO_4$, $(CaCrO_4)$.† Boil with $(NH_4)_2CO_3$ and $K_2C_2O_4$.

Residue: $SrCO_3$, (CaC_2O_4). Treat with HAc.

Solution: $SrAc_2$. Add Na_2SO_4.

Precipitate: $SrSO_4$.

Residue: (CaC_2O_4).

Filtrate: Ca and Mg salts. Add $K_2C_2O_4$.

Precipitate: CaC_2O_4, (MgC_2O_4). Treat with H_2SO_4.

Solution: $CaSO_4$, $(MgSO_4)$. Add C_2H_5OH.

Precipitate: $CaSO_4$.

Filtrate. Add Na_2HPO_4.

Precipitate: $MgNH_4PO_4$.

† Substances whose formulas are within parentheses are not normally found at the point indicated, but their presence (arising from faulty procedure or an excessive proportion of the element in the substance) is provided for in the confirmatory tests.

QUALITATIVE ANALYSIS SCHEME (Continued)

Analysis of the Alkali-Group

SHORTER LESS EXACT METHOD

Filtrate from the Ammonium Carbonate Precipitate: NH_4, K, Na salts. Evaporate, ignite, add HCl, ignite again.

Vapor: NH_4 salts.	Residue: KCl, NaCl. Add 3 cc. of water, and treat portions as follows:	
	Add $Na_3Co(NO_2)_6$.	Add KH_2SbO_4.
	Yellow precipitate: $K_2NaCo(NO_2)_6$. Test in flame.	Crystalline precipitate: NaH_2SbO_4.
	Violet color: K.	

EXACT METHOD

Filtrate from the Ammonium Carbonate Precipitate: NH_4, K, Na salts. Evaporate, and ignite the residue. Dissolve in water, add $BaCl_2$ (to remove sulfate), then $(NH_4)_2CO_3$ (to remove barium). Evaporate and ignite again.

Vapor: NH_4 salts.	Residue: KCl, NaCl. Add $HClO_4$, evaporate, add alcohol.		
	Residue: $KClO_4$. Dissolve in hot water, add $Na_3Co(NO_2)_6$.	Solution: $NaClO_4$. Saturate with HCl gas.	
	Yellow precipitate: $K_2NaCo(NO_2)_6$.	Precipitate: NaCl. Dissolve in water, add KH_2SbO_4.	Filtrate: Reject.
		Crystalline precipitate: NaH_2SbO_4.	

QUALITATIVE ANALYSIS SCHEME (Continued)

Supplementary Procedures for Basic Constituents

Boil the substance with NaOH solution.	Boil the substance with H_2SO_4; treat portions of the solution as follows:				
	Add $K_3Fe(CN)_6$.	Add KSCN.	Add $HgCl_2$.	Add HCl.	
Vapor: NH_3. Absorb in water; add K_2HgI_4.	Blue precipitate: $Fe_3(Fe(CN)_6)_2$. (Shows ferrous iron.)	Red color: $Fe(SCN)_3$. (Shows ferric iron.)	Precipitate: Hg_2Cl_2. (Shows stannous tin.)	Precipitate: Hg_2Cl_2 or AgCl. Add NH_4OH.	Filtrate. $HgCl_2$. Add $SnCl_2$.
Orange precipitate: $HgO \cdot Hg^{I}_{NH_2}$. (Shows ammonium.)				Black residue: Hg and $Hg^{Cl}_{NH_2}$. (Shows mercurous mercury.)	Precipitate: Hg_2Cl_2 or Hg. (Shows mercuric mercury.)

Acidic Constituents

Detection of Groups of Acidic Constituents

Sodium Carbonate solution containing all acidic constituents. Treat portions as follows:

Add $AgNO_3$, $NaNO_2$, and HNO_3	Add HAc, $BaCl_2$, and $CaCl_2$.	Add $MnCl_2$ and HCl.	Add HCl, $FeCl_3$, and $K_3Fe(Cn)_6$.
Precipitate: Chloride-group (S, CN, $Fe(CN)_6$iv, $Fe(CN)_6$iii, SCN, Cl, Br, I, ClO_3, ClO), as Ag salts.	Precipitate: Sulfate-group (SO_4, SO_3, CrO_4, F, C_2O_4), as Ba and Ca salts.	Dark Color: $MnCl_3$. Shows oxidizing constituents: $Fe(CN)_6$iii, ClO_3, ClO, CrO_4, NO_3, NO_2.	Blue precipitate: $Fe_4(Fe(CN)_6)_3$. Shows reducing constituents: S, $Fe(CN)_6$iv, I, SO_3, NO_2.

QUALITATIVE ANALYSIS SCHEME (Continued)

Separation of the Chloride-Group into Subgroups

Sodium Carbonate solution containing all acidic constituents. To a portion add $Pb(NO_3)_2$.

Black Precipitate: PbS. (Shows sulfide.)	Filtrate. Add HAc and $Ni(NO_3)_2$.		
	Precipitate: $Ni_2Fe(CN)_6$, $Ni_3(Fe(CN)_6)_2$, $Ni(CN)_2$. (Shows simple or complex cyanide.)	Filtrate: NaSCN, NaI, NaBr, NaCl, $NaClO_3$. Add $AgNO_3$ and HNO_3.	
		Precipitate: AgSCN, AgI, AgBr, AgCl. (Shows halide or thiocyanate.)	Filtrate: $AgClO_3$. Add $NaNO_2$.
			Precipitate: AgCl. (Shows chlorate or hypochlorite.)

Detection of the Separate Cyanides

Nickel Precipitate: $Ni_2Fe(CN)_6$, $Ni_3(Fe(CN)_6)_2$, $Ni(CN)_2$. Add NH_4OH.

Solution: $(NH_3)_4Ni(OH)_2$, $(NH_4)_4Fe(CN)_6$, $(NH_4)_3Fe(CN)_6$, NH_4CN. Add $AgNO_3$ and Na_2SO_3.

Precipitate: $Ag_4Fe(CN)_6$. Add HCl and $Fe(NO_3)_3$.	Filtrate: $NH_4Ag(CN)_2$, $Ni(NO_3)_2$, $AgNO_3$, and NH_4NO_3. Add HNO_3.		
Blue residue: $Fe_4(Fe(CN)_6)_3$ and AgCl. (Shows ferro or ferricyanide.)	Precipitate: $Ag_2(CN)_2$. Add $(NH_4)_2S$.		Filtrate: Ni, Ag, and NH_4 nitrates. Reject.
	Residue: Ag_2S. Reject.	Solution: NH_4CNS. Add $Fe(NO_3)_3$.	
		Red color: $Fe(CNS)_3$. (Shows cyanide.)	

QUALITATIVE ANALYSIS SCHEME (Continued)

Detection of Thiocyanate, Iodide, Bromide, and Chloride

Silver Precipitate: $AgSCN$, AgI, $AgBr$, $AgCl$. Treat with NH_4OH and $(NH_4)_2S$.

Residue: Ag_2S.	Solution: NH_4SCN, NH_4I, NH_4Br, NH_4Cl. Add HNO_3, $Fe(NO_3)_3$, and CCl_4.				
	CCl_4 layer: I_2. (Purple color shows iodide.)	Water layer: I_2, HBr, HCl, $Fe(SCN)_3$. (Red color shows thiocyanate.) Boil; then cool and add $KMnO_4$ and CCl_4.			
		Vapor: I_2.	CCl_4 layer: Br_2. (Orange color shows bromide.)	Water layer: Br_2, HCl, H_2SO_4. Boil; then add $AgNO_3$.	
				Vapor: Br_2.	Precipitate: AgCl. (Shows chloride.)

Detection of Sulfate, Sulfite, Chromate, Fluoride, and Oxalate

Sodium Carbonate solution containing all acidic constituents. Acidify with HCl, and add $BaCl_2$.

Precipitate: $BaSO_4$. (Shows sulfate.)	Filtrate: Na_2SO_3, $Na_2Cr_2O_7$, NaF, $Na_2C_2O_4$, $BaCl_2$. Add Br_2.		
	Precipitate: $BaSO_4$. (Shows sulfite.)	Filtrate: $Na_2Cr_2O_7$, NaF, $Na_2C_2O_4$, $BaCl_2$. Add NaAc and $CaCl_2$.	
		Yellow precipitate: $BaCrO_4$. White precipitate: CaF_2, CaC_2O_4. Treat portions as follows:	
		Heat with SiO_2 and H_2SO_4.	Dissolve in HNO_3, add $KMnO_4$, distill.
		Gas: SiF_4. Test with water.	Vapors: CO_2. Collect in $Ba(OH)_2$.
		Turbidity: H_2SiO_3. (Shows fluoride.)	Precipitate: $BaCO_3$. (Shows oxalate.)

Detection of Nitrate, Nitrite, Borate, Arsenate, and Arsenite

Sodium Carbonate solution containing all the acidic constituents. Treat portions as follows:

<table>
<tr><td>Boil with $NaOH$ and Al.</td><td colspan="2">Add HAc and CSN_2H_4.</td><td>Add HCl, C_2H_5OH, and turmeric.</td><td>Add HCl, NH_4OH, and $Mg(NO_3)_2$.</td><td></td></tr>
<tr><td>Vapor: NH_3. Test with K_2HgI_4.</td><td>Gas: N_2.</td><td>Solution: NH_4SCN. Add $FeCl_3$.</td><td rowspan="2">Orange color. (Shows borate.)</td><td>Precipitate: $MgNH_4AsO_4$. Treat with $AgNO_3$.</td><td>Filtrate: NH_4AsO_2. Pass in H_2S.</td></tr>
<tr><td rowspan="2">Red precipitate: $HgO \cdot HgNH_2I$. (Shows nitrate or nitrite.)</td><td colspan="2">Red color: $Fe(SCN)_3$.</td><td>Red residue: Ag_3AsO_4. (Shows arsenate.)</td><td>Yellow precipitate, As_2S_3. (Shows arsenite.)</td></tr>
<tr><td colspan="3">(Show nitrite.)</td></tr>
</table>

Detection of Phosphate and the Separate Halides

To portions of the HNO_3 solution of the substance.

<table>
<tr><td>Add $(NH_4)_2MoO_4$.</td><td>Add $FeCl_3$.</td><td colspan="3">Add NaAc, HAc, $KMnO_4$ and $CHCl_3$.</td></tr>
<tr><td rowspan="2">Yellow precipitate: $(NH_4)_3PO_4$, $12MoO_3$. (Shows phosphate.)</td><td rowspan="2">Red color: $Fe(SCN)_3$. (Shows thiocyanate.)</td><td rowspan="2">Chloroform layer, purple: I_2. (Shows iodide.)</td><td colspan="2">Water layer: add H_2SO_4, more $KMnO_4$ and $CHCl_3$.</td></tr>
<tr><td>Chloroform layer, orange: Br_2. (Shows bromide.)</td><td>Water layer: Boil out the Br_2, add HNO_3 and $AgNO_3$.</td></tr>
</table>

Detection of Readily Volatile Acidic Constituents

Heat the substance with dilute H_2SO_4.

Vapors: CO_2, SO_2, H_2S, NO_2, Cl_2, Br_2, I_2, HCN. Expose to the vapors:

<table>
<tr><td>$Ba(OH)_2$ solution.</td><td>PbAc paper.</td><td>Starch and KI paper.</td><td>$Fe(OH)_2$ or $Fe(OH)_3$ and NaOH on paper.</td></tr>
<tr><td rowspan="2">White turbidity: $BaCO_3$ or $BaSO_3$. (Shows carbonate, sulphite or thiosulphate.)</td><td rowspan="2">Black color: PbS. (Shows sulphide.)</td><td rowspan="2">Blue color: I_2 (Shows nitrite, hypochlorite, chlorate, bromate, or iodide.)</td><td>Formation of $Na_4Fe(CN)_6$. Dip in HCl.</td></tr>
<tr><td>Blue color: $Fe_4(Fe(CN)_6)_3$. (Shows cyanide.)</td></tr>
</table>

QUALITATIVE ANALYSIS SCHEME (Continued)

ANALYSIS OF NATURAL SUBSTANCES AND IGNEOUS PRODUCTS

Detection of Sulfate, Carbonate, Sulfide, and Cyanide

Boil 0.5 g. of the substance with HCl and Zn, collecting the distillate in $Ba(OH)_2$ solution; filter the mixture left in the distilling flask.

Filtrate from mixture in distilling flask. Add $BaCl_2$.	Distillate. Precipitate: $BaCO_3$. (Shows carbonate.) Solution: BaS, $Ba(CN)_2$.	
Precipitate: $BaSO_4$. (Shows sulfate.)	To a part of the mixture add HAc and $PbAc_2$.	To the rest of the mixture add $FeCl_2$, boil, add HCl.
	Black precipitate: PbS. (Shows sulfide.)	Blue precipitate: $Fe_4(FeCN_6)_3$. (Shows cyanide.)

Detection of Chloride, Fluoride, and Borate

Distill 1 g. of the substance, first (A) with H_2SO_4 alone, then (B) with addition of CH_3OH.

A. First distillate.		B. Second distillate: $B(OCH_3)_3$. Add HCl, C_2H_5OH, and turmeric.
To a portion add $AgNO_3$.	To the remainder add NaAc and $CaCl_2$.	
Precipitate: AgCl. (Shows chloride.)	Precipitate: CaF_2. (Shows fluoride.) Confirm by special test.	Orange or red color. (Shows borate.)

FLAME AND BEAD TESTS

Flame Colorations

VIOLET.

Potassium compounds. Purple red through blue glass. Easily obscured by sodium flame. Bluish green through green glass. Rubidium and Caesium compounds impart same flame as potassium compounds.

BLUES.

Azure. — Copper chloride. Copper bromide gives azure blue followed by green. Other copper compounds give same coloration when moistened with hydrochloric acid.

Light Blue. — Lead, Arsenic, Selenium.

GREENS.

Emerald. — Copper compounds except the halides, and when not moistened with hydrochloric acid.

Pure Green. — Compounds of thallium and tellurium.

Yellowish. — Barium compounds. Some molybdenum compounds. Borates, especially when treated with sulphuric acid or when burned with alcohol.

Bluish. — Phosphates with sulphuric acid.

Feeble. — Antimony compounds. Ammonium compounds.

Whitish. — Zinc.

REDS.

Carmine. — Lithium compounds. Violet through blue glass. Invisible through green glass. Masked by barium flame.

Scarlet. — Strontium compounds. Violet through blue glass. Yellowish through green glass. Masked by barium flame.

Yellowish. — Calcium compounds. Greenish through blue glass. Green through green glass. Masked by barium flame.

YELLOWS.

Yellow. All sodium compounds. Invisible with blue glass.

OXIDES WHICH IMPART DECIDED COLORS TO THE BEADS

Borax Beads

Oxides of	Oxidizing Flame	Reducing Flame
Chromium	Green	Green
Cobalt	Blue	Blue
Copper	Greenish blue	Red-opaque
Iron	Yellow	Green
Manganese	Violet	Colorless
Molybdenum	Colorless	Brown
Nickel	Brown	Gray-opaque
Titanium	Colorless	Yellow
Tungsten	Colorless	Brown
Uranium	Red	Green
Vanadium	Colorless	Green

FLAME AND BEAD TESTS (Continued)

Salt of Phosphorus Beads

Oxides of	Oxidizing Flame	Reducing Flame
Chromium	Green	Green
Cobalt	Blue	Blue
Copper	Blue	Red-opaque
Iron	Brown	Colorless
Manganese	Violet	Colorless
Molybdenum	Colorless	Green
Nickel	Yellow	Yellow
Titanium	Colorless	Violet
Tungsten	Colorless	Blue
Uranium	Green	Green
Vanadium	Yellow	Green

Sodium Carbonate Bead

Manganese	Green	Colorless

PREPARATION AND PROPER CONCENTRATION OF LABORATORY REAGENTS FOR GENERAL USE

Dilute Acids. Sulfuric acid. One volume concentrated acid to 6 volumes water.

Nitric Acid. One volume concentrated acid to 2 volumes water.

Hydrochloric acid. Five volumes concentrated acid to 8 volumes water.

Acetic acid. One volume concentrated acid to $2\frac{1}{2}$ volumes water.

Dilute Bases. Potassium hydroxide. 280 grams per liter of solution with water.

Sodium hydroxide. 200 grams per liter of solution with water.

Ammonium hydroxide. One volume concentrated ammonia (sp. gr. 90) to 2 volumes water.

Other Reagents. Ammonium sulfide. 600 cc. ammonium hydroxide is saturated with hydrogen sulfide. Dilute to one liter with ammonium hydroxide.

Sodium sulfide. Dissolve 200 grams sodium hydroxide in 800 cc. water. Saturate 400 cc. of this solution with hydrogen sulfide. Add the remaining 400 cc. of sodium hydroxide and dilute the whole to one liter.

Ammonium chloride. 267.5 grams per liter of solution with water.

Ammonium carbonate. 200 grams solid salt dissolved in 350 cc. ammonium hydroxide and dilute with water to 1 liter.

Ammonium acetate. Dilute 300 cc. concentrated acetic acid with 300 cc. water and neutralize with concentrated ammonia. Dilute to 1 liter.

Sodium acetate, 136.14 grams per liter with water.

Sodium phosphate, 119.45 grams per liter with water.

Calcium chloride, 109.51 grams per liter with water.

Magnesium sulfate, 123.28 grams per liter with water.

Barium chloride, 122.17 grams per liter with water.

Ferric chloride, 54.11 grams per liter with water and add sufficient HCl to keep in solution.

Potassium ferrocyanide, 105.72 grams per liter with water.

Lead acetate, 189.51 grams per liter with water.

Stannous chloride, 112.72 grams of the solid salt plus 200 cc. 5N HCl diluted to 1 liter with water. Add metallic tin to the solution in the bottle to keep it from oxidizing.

Mercurous nitrate, 262.34 grams per liter with water. Add sufficient nitric acid to keep solution clear and put metallic mercury in the bottle to prevent oxidation.

Cobalt nitrate, 145 grams per liter with water.

Ammonium oxalate, 35.5 grams per liter with water.

Mercuric chloride, 67.8 grams per liter with water.

Zinc sulfate, 71.9 grams per liter with water.

Manganese sulfate, 55.78 grams per liter with water.
Nickel sulfate, 70.22 grams per liter with water.
Cadmium sulfate, 64.05 grams per liter with water.
Copper sulfate, 62.4 grams per liter with water.

Miscellaneous Reagents. Aqua regia, mix 1 part concentrated HNO_3 with three parts of concentrated HCl.

Silver nitrate N/10, 17 grams per liter with water.

Magnesia mixture, dissolve 68 grams crystallized $MgCl_2$ and 165 grams NH_4Cl in 300 cc. water. Add 300 cc. dilute ammonium hydroxide and dilute to 1 liter.

Molybdate solution, dissolve 60 grams molybdic oxide (MoO_3) in 440 cc. of water and 60 cc. concentrated ammonia (sp. gr. 90). Pour into 500 cc. of cold nitric acid which has been diluted 250 cc. concentrated acid to 250 cc. water. Let stand in a warm place several days. Decant or filter before using.

Phenolsulfonic acid, dissolve 150 grams of phenol in 600 grams of concentrated sulfuric acid.

Yellow ammonium sulfide, 50 to 75 grams of sulfur to a liter of colorless ammonium sulfide.

Ferrous sulfate, dissolve 200 grams $FeSO_4.7H_2O$ in a liter of water. Place scraps of iron in the solution and add a few drops of H_2SO_4 from time to time.

SPECIAL SOLUTIONS AND REAGENTS

Acid Cuprous Chloride. Cover the bottom of a two-liter flask with copper oxide, extend from the top to the bottom of the bottle several pieces of copper wire, and fill the bottle with 1.10 sp. gr. hydrochloric acid. Shake occasionally, and when solution becomes nearly colorless pour into reagent bottles containing copper wire. The stock bottle should be kept filled with 1.10 hydrochloric acid.

Ammoniacal Cuprous Chloride. The acid solution, described above, is treated with ammonia until a slight odor of this reagent is noticeable. Copper wire should be kept in the solution.

Ammonium Molybdate. Mix well 100 gm. of molybdic acid with 400 cc. of distilled water and add 80 cc. of ammonia (sp. gr. 0.90). When complete solution has taken place pour slowly and with stirring into a mixture of 400 cc. of nitric acid (sp. gr. 1.42) and 600 cc. of distilled water. Add 50 milligrams of microcosmic salt, allow to stand 24 hrs. and filter.

Cochineal. Extract 1 gm. of cochineal for four days with 20 cc. of alcohol and 60 cc. of distilled water. Filter.

Congo Red. Dissolve 0.5 gm. of congo red in 90 cc. of distilled water and 10 cc. of alcohol.

Eschka's Compound. Two parts of calcined magnesia are thoroughly mixed with one part of anhydrous sodium carbonate.

Fehling Solution. A. *The Copper Sulphate Solution.* Dissolve 34.66 gm. of copper sulphate ($CuSO_4 \cdot 5H_2O$) in water and dilute to 500 cc. B. *The Alkaline Tartrate Solution.* Dissolve

173 gm. of potassium sodium tartrate (Rochelle salt, $KNaC_4H_4O_6 \cdot 4H_2O$) and 50 gm. of sodium hydroxide in water and dilute when cold to 500 cc. For use, mix equal volumes of the two solutions at the time of using.

Formaldehyde-Sulfuric Acid (Marquis Reagent). Add 10 cc. formaldehyde solution to 50 cc. sulfuric acid.

Fuchsin-Sulfurous Acid. To a solution of 0.5 gm. of fuchsin and 9 gm. of sodium bisulphite in 500 cc. of water add 10 cc. of hydrochloric acid. Keep in well-stoppered bottles and away from light.

Iodo-potassium Iodide (Wagner's Reagent). Dissolve 2 gm. of iodine and 6 gm. of potassium iodide in 100 cc. of water.

Litmus. Extract powder three times with boiling alcohol, each treatment consuming an hour. Treat residue with an equal weight of cold water and filter; then exhaust with five times its weight of boiling water, cool and filter.

Magnesia Mixture. Dissolve 110 gm. of magnesium chloride in a small amount of water. To this solution add 280 gm. of ammonium chloride and 700 cc. of ammonia (sp. gr. 0.90), and dilute to 2000 cc. After standing several hours the solution is filtered. From time to time filter off any silica that may accumulate from the reagent bottle.

Mayer's Reagent. Dissolve 1.35 gm. of mercuric chloride in 60 cc. of water and add to a solution of 5 gm. potassium iodide in 10 cc. of water; add sufficient water to make 100 cc.

Methyl Orange Solution. Dissolve 1 gm. of methyl orange in 1000 cc. of water.

Methyl Red. Dissolve 0.20 gm. of methyl red in 100 cc. of alcohol.

Millon's Reagent. Dissolve 1 part of mercury in 1 part of cold fuming nitric acid. Dilute with twice the volume of water and decant the clear solution after several hours.

Nessler's Solution. Dissolve 50 gm. of potassium iodide in the smallest possible quantity of cold water. Add a saturated solution of mercuric chloride until an excess is indicated by the formation of a precipitate. Add 400 cc. of a 50% solution of potassium hydroxide. Make up to 1 liter, allow to settle, and draw off the clear solution.

Phenolphthalein. Dissolve 1 gm. of phenolphthalein in 50 cc. of alcohol and add 50 cc. water.

Phosphomolybdic Acid (Sonnenschein's Reagent). Prepare ammonium phosphomolybdate and after washing with water, boil with nitric acid and expel NH_3; evaporate to dryness and dissolve in 10% nitric acid.

Phosphotungstic Acid (Scheibler's Reagent). Dissolve 20 gm. sodium tungstate and 15 gm. sodium phosphate in 100 cc. water containing a little nitric acid.

Picric Acid (Hager's Reagent). Dissolve 1 gm. picric acid in 100 cc. water.

Potassium-cadmium Iodide (Marme's Reagent). Add 2 gm. cadmium iodide to a boiling solution of 4 gm. potassium iodide

in 12 cc. water and then mix with an equal volume of saturated potassium iodide solution.

Rosolic Acid. Dissolve 1 gm. rosolic acid in 10 cc. alcohol and add 100 cc. water.

Soap Solution. Dissolve 100 gm. of dry castile soap in 1 liter of 80% alcohol. Allow to stand several days and dilute with 70% to 80% alcohol until 6.4 cc. produces a permanent lather with 20 cc. of standard calcium solution. The latter solution is made by dissolving 0.2 gm. of calcium carbonate in a small amount of dilute hydrochloric acid, evaporating to dryness, and making up to 1 liter.

Sodium Cobaltic Nitrite. Dissolve 4 gm. of cobalt nitrate and 10 gm. of sodium nitrite in 50 cc. of water, add 2 cc. of 36% acetic acid and make up to 100 cc.

Sodium Nitroprusside. Use a freshly prepared solution of 1 gm. sodium nitroprusside in 10 cc. of water.

Sulfanilic Acid. Dissolve 0.5 gm. sulfanilic acid in a mixture of 15 cc. glacial acetic acid and 135 cc. of recently boiled water.

Sulfomolybdic Acid (Froehde's Reagent). Dissolve 10 gm. molybdic acid or sodium molybdate in 100 cc. concentrated sulfuric acid.

Starch. Dissolve 5 gm. of soluble starch in cold water, pour the solution into 2 liters of hot water and boil for a few minutes. Keep in a glass-stoppered bottle.

Starch Solution from other than soluble starch. One part of starch is made into an emulsion with water and this is poured into 200 parts of boiling water, the boiling continued a few minutes, then the solution allowed to stand. Use only the clear solution.

Tannic Acid. Dissolve 1 gm. of tannic acid in 1 cc. of alcohol, and make up to 10 cc. with water.

Tincture of Iodine. To 50 cc. of water add 70 gm. of iodine and 50 gm. of potassium iodide. Make up to 1 liter with alcohol.

Trinitrophenol Solution. Dissolve 1 gm. of trinitrophenol in 100 cc. of water. Cool and filter.

Tumeric Tincture. Digest the ground tumeric root with several small quantities of water which are discarded. Dry the residue and digest it several days with six times its weight of alcohol and filter.

Tumeric Paper. Impregnate white, unsized paper with the tincture, and dry.

STANDARD SOLUTIONS FOR VOLUMETRIC ANALYSIS

Acids

Decinormal Succinic Acid. $H_2C_4H_4O_4$ (5.9024 g. per liter) Dry 5–6 g. of pure succinic acid in an open weighing bottle at 105° for about 10 hours; cool in a desiccator. Weigh out accurately 2.9512 g., brush into a 400 cc. beaker and dissolve in 150–200 cc. of water; pour the solution into a 500 cc. graduated flask, rinsing out the beaker several times to insure complete transference of the acid. Dilute to exactly 500 cc. and mix thoroughly. This prepares an exact decinormal solution.

Standard Hydrochloric Acid Solutions by the Method of G. A. Hulett and W. D. Bonner. *Jour. Am. Chem. Soc.* 31, 390 (1909). Standard HCl is easily prepared by starting with HCl of about d 1.10, made up with an ordinary hydrometer, distilling off and discarding the first three-fourths of the liquid taken; the distillate which is then collected does not differ by more than one part in 10,000 from the values in the table below. This constant boiling acid is not hygroscopic or noticeably volatile and is easily weighed in a small flask. By the use of a capillary pipette, to adjust the last amount of acid, it is a very simple matter to weigh out 180.155 g. to less than 10 mg. and this furnishes sufficient acid to make a liter of normal solution with an accuracy that is seldom attained even with very elaborate precautions.

Pressure mm Hg	%HCl	Grams of Constant Boiling Distillate for 1Mol. HCl.
770	20.218	180.375
760	20.242	180.155
750	20.266	179.945
740	20.290	179.730
730	20.314	179.515

Normal Hydrochloric Acid. (36.465 g. per liter) (*a*) 180.155 g. of constant boiling point (760 mm.) acid diluted to 1 liter gives an exactly normal solution. (*b*) Concentrated HCl diluted to d 1.020 is approximately normal. (*c*) Concentrated HCl. contains about one-third of its weight of HCl and 120 g. diluted with water to 1 liter will give an acid slightly greater than normal. Solutions prepared as in *b* or *c* are most accurately standardized by precipitation as AgCl.

Normal Sulfuric Acid. (49.04 g. per liter) Take 30 cc. of pure, concentrated H_2SO_4, d 1.84 and pour it cautiously and slowly into about 3–4 volumes of water, cool, mix thoroughly and dilute to 1 liter. Standardize by titration with standard NaOH or KOH solutions with phenolphthalein as indicator. For a decinormal solution use 3 cc. H_2SO_4 per liter and proceed as above. Sulfuric acid is obtained easily in a pure form; the normal acid solution is not affected by boiling (advantage over similar HNO_3

or HCl solutions); when used with lime or similar compounds it gives precipitates and for such cases HCl is preferable.

Normal Nitric Acid. (63.016 g. per liter) Use a colorless acid, d 1.3±, free from chlorine and nitrous acid; a yellow color due to lower oxides of nitrogen is removed by adding about 2 volumes of water, boiling, cooling and then diluting to volume. 65 cc. or 93 g. of acid, d 1.42 diluted to 1 liter gives an acid slightly greater than normal. Standardize by titration with standard alkali.

Normal Oxalic Acid. $H_2C_2O_4$ (63.024 g. $H_2C_2O_4.2H_2O$ or 45.008 g. $H_2C_2O_4$ per liter) Because of the uncertainty in the amount of water of crystallization, standards can not be prepared directly by dissolving a weighed quantity of acid; it is necessary to standardize the solution against alkali of known concentration using phenolphthalein as an indicator. Decinormal or less concentrated solutions are unstable and should be prepared fresh when needed; more concentrated solutions may deposit some of the acid when cooled to low temperatures but they are fairly stable at room temperature when protected from light.

Alkalis

Normal Sodium Hydroxide. * (40.005 g. per liter) Dissolve about 42 g. NaOH in cold water which has been previously boiled to expel CO_2 and dilute to 1 liter with CO_2 free water; a small amount of $BaCl_2$ or $Ba(OH)_2$ solution may be added and after allowing the $BaCO_3$ to settle, the clear supernatant solution is decanted. In preparing the solution exposure to air should be avoided as much as possible. Standardize with normal H_2SO_4 using methyl orange indicator. Solutions thus prepared are slightly greater than normal but after preliminary titration with acid are easily adjusted by the addition of the proper amount of water. The solution must be kept in a bottle with the stopper lubricated with a small amount of vaseline.

Normal Potassium Hydroxide.* (56.104 g. per liter) Proceed as with normal sodium hydroxide using 58 g. KOH.

Decinormal Potassium Hydroxide.* (5.6104 g. per liter) Dissolve 7 g. KOH in about 400 cc. of water, add a little $BaCl_2$ solution to precipitate the carbonate and allow to stand about 15 minutes until the $BaCO_3$ settles, filter into a 1 liter flask and without washing the precipitate, dilute to 1 liter with CO_2 free water. Standardize with 0.1 N sulfuric, hydrochloric or succinic acids, using phenolphthalein or methyl orange indicator. Solutions thus prepared are slightly greater than 0.1 N but after preliminary titration with acid are easily adjusted by the addition of the proper amount of water.

Decinormal Sodium Hydroxide.* (4.0005 g. per liter) Dissolve 6 g. NaOH in water and proceed as with 0.1 N KOH.

* The correction factors of NaOH or KOH solutions may change rapidly because of absorption of CO_2 and for this reason should be protected as much as possible from exposure to the air. It is best to standardize these alkaline solutions just before use and when phenolphthalein is used as the indicator to use water which has been boiled recently to expel CO_2 and then cooled. The presence of CO_2 is without effect when methyl orange is the indicator.

Half Normal Ammonium Hydroxide. (17.524 g. per liter) Dilute 28 cc. of ammonium hydroxide, d 0.880 to 1 liter and standardize with sulfuric or hydrochloric acid using cochineal or methyl orange as indicator. Normal solutions of ammonium hydroxide are likely to lose NH_3 at room temperatures.

Oxidizing and Reducing Solutions

Decinormal Potassium Permanganate. $Mn^{vii} \rightarrow Mn^{ii}$ (3.1605 g. per liter) Dissolve 3.3 g. dry $KMnO_4$ in 1 liter distilled water and allow to stand at least 24 hours in a clean glass stoppered bottle. The reasons for not using the freshly prepared solution are: 1st the reducing agents in the water (dust, etc.) are thus all oxidized, and 2nd any MnO_2 formed by this reduction is permitted to settle. The solution is then carefully siphoned through a clean glass tube into clean beakers, discarding the first 25 cc. of solution and the last inch of the solution in the bottle which contains the precipitated MnO_2; the $KMnO_4$ solution should never be permitted to come in contact with rubber, filter paper or other organic matter. The solution in the beakers is now poured back into a clean bottle and standardized against sodium oxalate. Weigh out several samples of 0.25–0.3 g. of a very pure grade and previously dried sodium oxalate and transfer each to 250 cc. Erlenmeyer flasks, add 150 cc. water and 4 cc. concentrated H_2SO_4, heat nearly to boiling and when dissolved run in $KMnO_4$ not faster than 10–15 cc. per minute, swirling the flask rapidly to mix the solutions; the last 1 cc. is added dropwise allowing the solution to decolorize completely before the next addition. The temperature of the solution must be kept above 60°C. and may be heated again if necessary. The addition of $KMnO_4$ is continued until a *faint*, permanent pink is obtained. The first titration may not be exact but will give a fair approximation of the amount necessary for the remaining samples of oxalate. 1 cc. of 0.1 N $KMnO_4$ is equivalent to 0.0067 g. sodium oxalate.

Decinormal Potassium Dichromate. $Cr^{vi} \rightarrow Cr^{iii}$ (4.9035 g. per liter) Dry about 6 g. of $K_2Cr_2O_7$ crystals in an oven for an hour and cool in a desiccator. Weigh out exactly 4.9035 g., place in a liter flask and dilute to exactly 1 liter. This solution is exactly decinormal and can be used for titrating in the standardization of thiosulfate solution. For use in Fe titration it should be checked against pure iron wire by weighing out accurately two samples of wire of 150–200 mg. each. These samples are dissolved separately in beakers with 20 cc. H_2O and 6 cc. HCl. A few particles of carbon may remain undissolved. The solutions are heated nearly to boiling and 2–3 drops of $SnCl_2$ solution are added to reduce any ferric salt formed by oxidation during solution. After cooling and diluting to about 50 cc., an excess of $HgCl_2$ is added (10 cc. of a saturated solution of $HgCl_2$) to reduce the excess $SnCl_2$. The $K_2Cr_2O_7$ solution is added from a burette until within 2 cc. of the quantity calculated from the amount of iron dissolved. The last amount of $K_2Cr_2O_7$ is added slowly and the end point determined using $K_3Fe(CN)_6$

as an external indicator (one small crystal of $K_3Fe(CN)_6$ in 30 cc. H_2O). A blue color is obtained as long as ferrous iron is present. When no blue color is obtained after 30 seconds the end point is attained. Since the Fe wire is not absolutely pure, the weight of iron sample is multiplied by the percentage of iron in the wire. 0.005584 g. Fe is equivalent to 1 cc. 0.1 N solution.

Decinormal Sodium Thiosulfate. $2Na_2S_2O_3 \rightarrow Na_2S_4O_6$ (24.8202 g. $Na_2S_2O_3.5H_2O$ per liter) Do not dry the sodium thiosulfate in an oven as it can be obtained almost pure; weigh out 28.50 g. and dilute to exactly 1 liter. After mixing thoroughly the solution is allowed to stand two weeks. If free sulfur has separated, the clear liquid is siphoned off. The solution is standardized indirectly by titration with potassium dichromate (*see above*). Dissolve 5 g. KI and 4 g. $NaHCO_3$ in 300 cc. H_2O in a 500 cc. Erlenmeyer flask at room temperature and then add HCl slowly, swirling the flask, until there is no more evolution of CO_2 and then add about 10 cc. more acid; add 35 cc. 0.1 N $K_2Cr_2O_7$, mixing the solutions, rinse the sides of the flask with a few cc. of water, allowing it to form a layer over the solution without mixing; stopper the flask and allow to stand about 10 minutes. Then with thorough mixing run in thiosulfate until the solution is a light yellow, add a few drops of starch solution and continue with a slow addition of thiosulfate until the bright blue color has disappeared and only the pale green color of $CrCl_3$ remains.

Decinormal Iodine. $I_2 \rightarrow 2HI$ (12.6932 g. per liter) Dissolve about 13.5 g. pure sublimed iodine in a sulution of 24 g. KI in 200 cc. H_2O and dilute to 1 liter. The solution is standardized by adding the iodine to a known volume of standard thiosulfate with a few drops of starch solution for the indicator.

Decinormal Alkaline Arsenite $As^{iii} \rightarrow As^{v}$ (4.948 g. As_2O_3 per liter; equivalent to 0.0126932 g. I or 0.0035457 g. Cl per cc.) Dissolve 4.948 g. pure sublimed As_2O_3 in a concentrated solution of 4 g. NaOH, add 100 cc. of a saturated $NaHCO_3$ solution and dilute to 1 liter. Do not warm the solution above 60° C. when dissolving the As_2O_3. Standardize against standard iodine solution with a starch indicator.

TRUE CAPACITY OF GLASS VESSELS FROM THE WEIGHT OF THE CONTAINED WATER OR MERCURY WHEN WEIGHED IN AIR WITH BRASS WEIGHTS*

A glass vessel containing G grams of water at a temperature of t°C has, at the same temperature, a capacity $V = W_t \times G$ cubic centimeters. Similarly when filled with G grams of mercury at a temperature of t°C the capacity at the same temperature is given by $V = M_t \times G$ cubic centimeters.

A glass vessel containing G grams of water at a temperature of t°C has a capacity at a temperature of 18°C given by $V = W_{18°} \times G$ cubic centimeters. Similarly when filled with G grams of mercury at a temperature of t°C the capacity at a temperature of 18°C is given by $V = M_{18°} \times G$ cubic centimeters. The true volume at temperature of 25°C when the weighing is made at t° is similarly obtained by use of the values under $W_{25°}$ and $M_{25°}$ for water and mercury respectively.

t°C.	W_t	M_t	$W_{18°}$	$M_{18°}$	$W_{25°}$	$M_{25°}$
0	1.001193	0.0735501	1.001643	0.0735832	1.001818	0.0735960
1	1.001133	0.0735636	1.001559	0.0735949	1.001734	0.0736077
2	1.001092	0.0735771	1.001492	0.0736066	1.001668	0.0736194
3	1.001068	0.0735907	1.001443	0.0736183	1.001618	0.0736311
4	1.001060	0.0736037	1.001410	0.0736294	1.001586	0.0736423
5	1.001068	0.0736172	1.001394	0.0736411	1.001569	0.0736540
6	1.001092	0.0736308	1.001392	0.0736529	1.001568	0.0736657
7	1.001131	0.0736492	1.001406	0.0736695	1.001581	0.0736824
8	1.001184	0.0736628	1.001435	0.0736812	1.001610	0.0736941
9	1.001252	0.0736763	1.001477	0.0736929	1.001652	0.0737058
10	1.001333	0.0736894	1.001534	0.0737042	1.001709	0.0737171
11	1.001428	0.0736975	1.001603	0.0737104	1.001779	0.0737233
12	1.001536	0.0737111	1.001686	0.0737222	1.001862	0.0737351
13	1.001657	0.0737241	1.001782	0.0737333	1.001957	0.0737463
14	1.001790	0.0737377	1.001890	0.0737451	1.002066	0.0737581
15	1.001935	0.0737513	1.002010	0.0737569	1.002186	0.0737698
16	1.002092	0.0737644	1.002143	0.0737681	1.002318	0.0737810
17	1.002261	0.0737780	1.002286	0.0737798	1.002462	0.0737927
18	1.002441	0.0737911	1.002441	0.0737911	1.002617	0.0738039
19	1.002633	0.0738047	1.002608	0.0738028	1.002783	0.0738157
20	1.002835	0.0738183	1.002785	0.0738146	1.002960	0.0738275
21	1.003047	0.0738314	1.002972	0.0738258	1.003148	0.0738398
22	1.003271	0.0738450	1.003170	0.0738376	1.003346	0.0738505
23	1.003504	0.0738581	1.003379	0.0738489	1.003554	0.0738618
24	1.003748	0.0738717	1.003597	0.0738607	1.003773	0.0738736
25	1.004001	0.0738848	1.003825	0.0738719	1.004001	0.0738848
26	1.004264	0.0738985	1.004063	0.0738837	1.004239	0.0738966
27	1.004537	0.0739116	1.004310	0.0738950	1.004486	0.0739079
28	1.004819	0.0739253	1.004567	0.0739068	1.004743	0.0739197
29	1.005110	0.0739384	1.004833	0.0739181	1.005009	0.0739310
30	1.005410	0.0739520	1.005109	0.0739299	1.005284	0.0739428

* Assuming 25×10^{-6} as the coefficient of cubic expansion for glass.

Reduction of Weighings to Vacuo

If the apparent mass of a body is m, its density d_m, the density of the weights d_w and the density of the air d_a the true mass in vacuo is,

$$M = m + md_a\left(\frac{1}{d_m} - \frac{1}{d_w}\right)$$

DECI-NORMAL SOLUTIONS OF SALTS AND OTHER REAGENTS

The weight in grams of the compound in 1 c.c. of the following deci-normal solutions is found by dividing the H equivalent in the last column by 1000.

Name	Formula	At. or mol. wt.	Hydrogen equivalent	One H equiv. in gms.
Acetic acid	$HC_2H_3O_2$	60.03	$HC_2H_3O_2$	6.003
Ammonia	NH_3	17.03	NH_3	1.703
Ammonium	NH_4	18.04	NH_4	1.804
Ammonium chloride	NH_4Cl	53.50	NH_4Cl	5.350
Ammonium sulfate	$(NH_4)_2SO_4$	132.14	$\frac{1}{2}(NH_4)_2SO_4$	6.607
Ammonium sulfocyanate	NH_4CNS	76.11	NH_4CNS	7.611
Barium	Ba	137.37	$\frac{1}{2}Ba$	6.869
Barium carbonate	$BaCO_3$	197.37	$\frac{1}{2}BaCO_3$	9.869
Barium chloride	$BaCl_2.2H_2O$	244.32	$\frac{1}{2}BaCl_2.2H_2O$	12.216
Barium hydroxide	$Ba(OH)_2$	171.39	$\frac{1}{2}Ba(OH)_2$	8.569
Barium oxide	BaO	153.37	$\frac{1}{2}BaO$	7.669
Bromine	Br	79.92	Br	7.992
Calcium	Ca	40.07	$\frac{1}{2}Ca$	2.004
Calcium carbonate	$CaCO_3$	100.07	$\frac{1}{2}CaCO_3$	5.004
Calcium chloride	$CaCl_2$	110.98	$\frac{1}{2}CaCl_2$	5.549
Calcium chloride	$CaCl_2.6H_2O$	219.08	$\frac{1}{2}CaCl_2.6H_2O$	10.954
Calcium hydroxide	$Ca(OH)_2$	74.09	$\frac{1}{2}Ca(OH)_2$	3.704
Calcium oxide	CaO	56.07	$\frac{1}{2}CaO$	2.804
Chlorine	Cl	35.46	Cl	3.546
Citric acid	$C_6H_8O_7.H_2O$	210.08	$\frac{1}{3}C_6H_8O_7.H_2O$	7.003
Cobalt	Co	58.94	$\frac{1}{2}Co$	2.948
Copper	Cu	63.57	$\frac{1}{2}Cu$	3.179
Copper Oxide	CuO	79.57	$\frac{1}{2}CuO$	3.979
Copper sulfate	$CuSO_4.5H_2O$	249.71	$\frac{1}{2}CuSO_4.5H_2O$	12.486
Cyanogen	CN	26.01	CN	2.601
Hydrochloric acid	HCl	36.47	HCl	3.647
Hydrocyanic acid	HCN	27.02	HCN	2.702
Iodine	I	126.93	I	12.693
Lactic acid	$C_3H_6O_3$	90.05	$C_3H_6O_3$	9.005
Malic acid	$C_4H_6O_5$	134.05	$\frac{1}{2}C_4H_6O_5$	6.702
Magnesium	Mg	24.32	$\frac{1}{2}Mg$	1.216
Magnesium carbonate	$MgCO_3$	84.32	$\frac{1}{2}MgCO_3$	4.216
Magnesium chloride	$MgCl_2$	95.23	$\frac{1}{2}MgCl_2$	4.762
Magnesium chloride	$MgCl_2.6H_2O$	203.33	$\frac{1}{2}MgCl_2.6H_2O$	10.167
Magnesium oxide	MgO	40.32	$\frac{1}{2}MgO$	2.016
Manganese	Mn	54.93	$\frac{1}{2}Mn$	2.747
Manganese sulfate	$MnSO_4$	150.99	$\frac{1}{2}MnSO_4$	7.550
Mercuric chloride	$HgCl_2$	271.52	$\frac{1}{2}HgCl_2$	13.576
Nickel	Ni	58.69	$\frac{1}{2}Ni$	2.935
Nitric acid	HNO_3	63.02	HNO_3	6.302
Nitrogen	N	14.01	N	1.401
Nitrogen pentoxide	N_2O_5	108.02	$\frac{1}{5}N_2O_5$	5.401
Oxalic acid	$H_2C_2O_4$	90.02	$\frac{1}{2}H_2C_2O_4$	4.501
Oxalic acid	$H_2C_2O_4.2H_2O$	126.05	$\frac{1}{2}H_2C_2O_4.2H_2O$	6.302
Oxalic anhydride	C_2O_3	72.00	$\frac{1}{2}C_2O_3$	3.600
Phosphoric acid	H_3PO_4	98.05	$\frac{1}{3}H_3PO_4$	3.268
Potassium	K	39.10	K	3.910
Potassium bicarbonate	$KHCO_3$	100.10	$KHCO_3$	10.010
Potassium carbonate	K_2CO_3	138.19	$\frac{1}{2}K_2CO_3$	6.910
Potassium chloride	KCl	74.55	KCl	7.455
Potassium cyanide	KCN	65.10	KCN	6.510
Potassium hydroxide	KOH	56.10	KOH	5.610
Potassium oxide	K_2O	94.19	$\frac{1}{2}K_2O$	4.710
Potassium permanganate for Co estimation	$KMnO_4$	158.03	$\frac{1}{6}KMnO_4$	2.634

DECI-NORMAL SOLUTIONS OF SALTS AND OTHER REAGENTS (Continued.)

Name	Formula	At. or mol. wt.	Hydrogen equivalent	One H equiv. in gms.
Potassium permanganate for Mn estimation	$KMnO_4$	158.03	$\frac{1}{5}KMnO_4$	5.268
Potassium tartrate	$K_2H_4C_4O_6$	226.22	$\frac{1}{2}K_2H_4C_4O_6$	11.311
Silver	Ag	107.88	Ag	10.788
Silver nitrate	$AgNO_3$	169.89	$AgNO_3$	16.989
Sodium	Na	23.00	Na	2.300
Sodium bicarbonate	$NaHCO_3$	84.01	$NaHCO_3$	8.401
Sodium carbonate	Na_2CO_3	105.99	$\frac{1}{2}Na_2CO_3$	5.300
Sodium chloride	$NaCl$	58.45	$NaCl$	5.845
Sodium hydroxide	$NaOH$	40.01	$NaOH$	4.001
Sodium oxide	Na_2O	61.99	$\frac{1}{2}Na_2O$	3.100
Sodium sulfide	Na_2S	78.06	$\frac{1}{2}Na_2S$	3.903
Succinic acid	$H_2C_4H_4O_4$	118.05	$\frac{1}{2}H_2C_4H_4O_4$	5.902
Sulfuric acid	H_2SO_4	98.08	$\frac{1}{2}H_2SO_4$	4.904
Sulfur trioxide	SO_3	80.06	$\frac{1}{2}SO_3$	4.003
Tartaric acid	$C_4H_6O_6$	150.05	$\frac{1}{2}C_4H_6O_6$	7.502
Zinc	Zn	65.38	$\frac{1}{2}Zn$	3.269
Zinc sulfate	$ZnSO_4.7H_2O$	287.56	$\frac{1}{2}ZnSO_4.7H_2O$	14.378

DECI-NORMAL SOLUTIONS OF OXIDATION AND REDUCTION REAGENTS

Name	Formula	At. or mol. wt.	Hydrogen equivalent	One H equiv. in gms.
Antimony	Sb	121.77	$\frac{1}{3}$Sb	6.089
Arsenic	As	74.96	$\frac{1}{3}$As	3.748
Arsenic trisulfide	As_2S_3	246.11	$\frac{1}{6}As_2S_3$	6.153
Arsenous oxide	As_2O_3	197.92	$\frac{1}{6}As_2O_3$	4.948
Barium peroxide	BaO_2	169.37	$\frac{1}{2}BaO_2$	8.469
Barium peroxide, hydrated	$BaO_2.8H_2O$	313.50	$\frac{1}{2}BaO_2.8H_2O$	15.675
Calcium	Ca	40.07	$\frac{1}{2}$Ca	2.004
Calcium carbonate	$CaCO_3$	100.07	$\frac{1}{2}CaCO_3$	5.004
Calcium hypochlorite	$Ca(ClO)_2$	142.98	$\frac{1}{2}Ca(ClO)_2$	7.149
Calcium oxide	CaO	56.07	$\frac{1}{2}$CaO	2.804
Chlorine	Cl	35.46	Cl	3.546
Chromium trioxide	CrO_3	100.01	$\frac{1}{3}CrO_3$	3.334
Ferrous ammonium sulfate	$FeSO_4(NH_4)_2SO_4.6H_2O$	392.14	$FeSO_4(NH_4)_2SO_4.6H_2O$	39.214
Hydroferrocyanic acid	$H_4Fe(CN)_6$	215 92	$H_4Fe(CN)_6$	21.592
Hydrogen peroxide	H_2O_2	34.02	$\frac{1}{2}H_2O_2$	1.701
Hydrogen sulfide	H_2S	34.08	$\frac{1}{2}H_2S$	1.704
Iodine	I	126.93	I	12.693
Iron	Fe	55.84	Fe	5.584
Iron oxide, ferrous	FeO	71.84	FeO	7.184
Iron oxide, ferric	Fe_2O_3	159.68	$\frac{1}{2}Fe_2O_3$	7.984
Lead peroxide	PbO_2	239.20	$\frac{1}{2}PbO_2$	11.960
Manganese peroxide	MnO_2	86.93	$\frac{1}{2}MnO_2$	4.347
Nitric acid	HNO_3	63.02	$\frac{1}{3}HNO_3$	2.101
Nitrogen trioxide	N_2O_3	76.02	$\frac{1}{4}N_2O_3$	1.800
Nitrogen pentoxide	N_2O_5	108.02	$\frac{1}{4}N_2O_5$	1.800
Oxalic acid	$C_2H_2O_4$	90.02	$\frac{1}{2}C_2H_2O_4$	4.501
Oxalic acid	$C_2H_2O_4.2H_2O$	126 05	$\frac{1}{2}C_2H_2O_4.2H_2O$	6.302
Oxygen	O	1o.00	$\frac{1}{4}$O	0.800
Potassium bichromate	$K_2Cr_2O_7$	294.21	$\frac{1}{6}K_2Cr_2O_7$	4.903
Potassium chlorate	$KClO_3$	122.55	$\frac{1}{6}KClO_3$	2.043
Potassium chromate	K_2CrO_4	194.20	$\frac{1}{2}K_2CrO_4$	6.473
Potassium ferrocyanide	$K_4Fe(CN)_6$	368.27	$K_4Fe(CN)_6$	36.833
Potassium ferrocyanide	$K_4Fe(CN)_6.3H_2O$	422.32	$K_4Fe(CN)_6.3H_2O$	42.232
Potassium iodide	KI	166.03	KI	16.603
Potassium nitrate	KNO_3	101.10	$\frac{1}{2}KNO_3$	3.370
Potassium perchlorate	$KClO_4$	138.55	$\frac{1}{8}KClO_4$	1.732
Potassium permanganate	$KMnO_4$	158.03	$\frac{1}{5}KMnO_4$	3.161
Sodium chlorate	$NaClO_3$	106.45	$\frac{1}{6}NaClO_3$	1.774
Sodium nitrate	$NaNO_3$	85.01	$\frac{1}{3}NaNO_3$	2.834
Sodium thiosulfate	$Na_2S_2O_3.5H_2O$	248.20	$Na_2S_2O_3.5H_2O$	24.820
Stannous chloride	$SnCl_2$	189.61	$\frac{1}{2}SnCl_2$	9.481
Stannus oxide	SnO	134.70	$\frac{1}{2}$SnO	6.735
Sulfur dioxide	SO_2	64.06	$\frac{1}{2}SO_2$	3.203
Tin	Sn	118.70	$\frac{1}{2}$Sn	5.935

VOLUMETRIC QUANTITATIVE REACTIONS WITH GRAM EQUIVALENTS

Aluminum

(1) $Al_2(SO_4)_3 + 6KOH = 2Al(OH)_3 + 3K_2SO_4$

$$KOH = \frac{Al_2(SO4)_3}{6} = \frac{Al_2O_3}{6} = \frac{Al}{3}$$

Antimony

(2) $SbCl_5 + 2KI = SbCl_3 + 2KCl + I_2$

$$I = \frac{Sb}{2} = \frac{Sb_2O_5}{4}$$

(3) $Sb_2O_3 + 2I_2 + 2H_2O = Sb_2O_5 + 4HI$

$$I = \frac{Sb_2O_3}{4} = \frac{Sb}{2}$$

(4) (a) $Sb_2S_3 + 6HCl = 2SbCl_3 + 3H_2S$
(b) $3H_2S + 3I_2 = 6HI + 3S$

$$I = \frac{H_2S}{2} = \frac{Sb_2S_3}{6} = \frac{Sb}{3}$$

(5) $5Sb_2(SO_4)_3 + 4KMno_4 + 24H_2O = 10H_3SbO_4 + 2K_2SO_4 + 4MnSO_4 + 9H_2SO_4$

$$\frac{4KMno4}{20} = \frac{Sb_2(SO_4)_3}{4} = \frac{Sb_2O_3}{4} = \frac{Sb}{2}$$

Arsenic

(6) $As_2O_3 + 2H_2O + 2I_2 = As_2O_5 + 4HI$

$$I = \frac{As_2O_3}{4} = \frac{As}{2}$$

(7) $AsCl_3 + I_2 + 2HCl = AsCl_5 + 2HI$

$$I = \frac{AsCl_3}{2} = \frac{As}{2}$$

(8) As_2S_3 same as reaction 4

Boron

(9) (a) $Na_2B_4O_7 + 2HCl + 5H_2O + 2NaCl + 4H_3BO_3$
(b) $H_3BO_3 + NaOH = NaBO_2 + 2H_2O$

$$NaOH = H_3BO_3 = B$$

Cadmium

(10) $CdS + 2HCl + I_2 = CdCl_2 + 2HI + S$

$$I = \frac{CdS}{2} = \frac{Cd}{2} = \frac{S}{2}$$

Calcium

(11) $5CaC_2O_4 + 2KMno_4 + 8H_2SO_4 = 5CaSO_4 + K_2SO_4 + 2MnSO_4 + 8H_2O + 10CO_2$

$$\frac{2KMno4}{10} = \frac{CaC_2O_4}{2} = \frac{CaCO_3}{2} = \frac{CaO}{2}$$

(12) $CaCO_3 + 2HCl = CaCl_2 + CO_2 + H_2O$

$$HCl = \frac{CaCO_3}{2} = \frac{CaO}{2}$$

VOLUMETRIC QUANTITATIVE REACTIONS WITH GRAM EQUIVALENTS (Continued)

Carbon

(13) $Na_2CO_3 + H_2SO_4 = Na_2SO_4 + H_2O + CO_2$

$$\frac{H_2SO_4}{2} = \frac{Na_2CO_3}{2}$$

(14) $2NaHCO_3 + H_2SO_4 = Na_2SO_4 + 2H_2O + 2CO_2$

$$\frac{H_2SO_4}{2} = \frac{NaHCO_3}{1}$$

(15) $KHC_2O_4 + KOH = K_2C_2O_4 + H_2O$

$$KOH = KHC_2O_4$$

(16) $H_2C_2O_4.2H_2O + 2NaOH = Na_2C_2O_4 + 4H_2O$

$$NaOH = \frac{H_2C_2O_4.2H_2O}{2}$$

(17) $C_2H_5COOH + NaOH = C_6H_5COONa + H_2O$

$$NaOH = C_6H_5COOH$$

(18) $5Na_2C_2O_4 + 2KMnO_4 + 8H_2SO_4 = 5Na_2SO_4 + K_2SO_4 + 2MnSO_4 + 10CO_2 + 8H_2O$

$$\frac{2KMnO_4}{10} = \frac{Na_2C_2O_4}{2}$$

Chlorine

(19) $NaCl + AgNO_3 = AgCl + NaNO_3$

$$NaCl = Cl$$

(20) (a) $Cl + KI = KCl + I$

(b) $I_2 + 2Na_2S_2O_3 = Na_2S_4O_6 + 2NaI$

$$I = Cl$$

(21) $CaOCl_2 + 2HCl = CaCl_2 + H_2O + Cl_2$

$$I = Cl = \frac{CaOCl_2}{2}$$

Chromium

(22) $K_2Cr_2O_7 + 6FeCl_2 + 14HCl = 6FeCl_3 + 2KCl + 2CrCl_3 + 7H_2O$

$$\frac{Fe}{6} = \frac{K_2Cr_2O_7}{6} = \frac{Cr_2O_3}{6} = \frac{Cr}{3}$$

(23) $K_2Cr_2O_7 + 6KI + 7H_2SO_4 = 4K_2SO_4 + Cr_2(SO_4)_3 + 7H_2O + 3I_2$

$$I = \frac{K_2Cr_2O_7}{6} = \frac{Cr_2O_3}{6} = \frac{Cr}{3}$$

Copper ($KMnO_4$ Method)

(24) (a) $2CuSO_4 + 2KCNS + H_2SO_3 + H_2O = 2CuCNS + K_2SO_4 + 2H_2SO_4$

(b) $CuCNS + NaOH = NaCNS + CuOH$

(c) $5NaCNS + 6KMnO_4 + 4H_2SO_4 + 3K_2SO_4 + 6MnSO_4 + 5NaCN + 4H_2O$

$$\frac{6KMnO_4}{30} = \frac{NaCNS}{6} = \frac{CuSO_4}{6} = \frac{Cu}{6}$$

VOLUMETRIC QUANTITATIVE REACTIONS WITH GRAM EQUIVALENTS (Continued)

(25) (Iodide Method)

$$2CuSO_4 + 4KI = 2CuI + K_2SO_4 + I_2$$

$$I = CuSO_4 = Cu$$

(26) (KCN Method)

(a) $2CuSO_4 + 2NH_4OH = (NH_4)_2SO_4 + Cu_2SO_4(OH)_2$

(b) $Cu_2SO_4(OH)_2 + 6NH_3 + (NH_4) = 2Cu(NH_3)_4SO_4.H_2O$

(c) $Cu(NH_3)_4SO_4.H_2O + 7KCN = K_3NH_4Cu_2(CN)_6 + NH_4CNO + 2K_2SO_4 + 6NH_3 + H_2O$

$$\frac{KCN}{2} = \frac{2Cu(NH_3)_4SO_4.H_2O}{7} = \frac{CuSO_4}{7} = \frac{Cu}{7}$$

Iodine

(27) $I_2 + 2Na_2S_2O_3 = Na_2S_4O_6 + 2NaI$

$$I = Na_2S_2O_3$$

(28) $KIO_3 + 5KI + 6HCl = 6KCl + 3H_2O + 3I_2$

$$I = \frac{KIO_3}{6} = \frac{5KI}{6}$$

(29) $10KI + 2KMno_4 + 8H_2SO_4 = 6K_2SO_4 + 2MnSo_4 + 8H_2O + 5I_2$

$$\frac{2KMno_4}{10} = I$$

Iron

(30) $6FeCl_2 + K_2Cr_2O_7 + 14HCl = 6FeCl_3 + 2KCl + 2CrCl_3 + 7H_2O$

$$\frac{K_2Cr_2O_7}{6} = \frac{6FeCl_2}{6} = \frac{Fe_2O_3}{2} = \frac{Fe}{1}$$

(31) $10FeSO_4 + KMnO_4 + 8H_2SO_4 = 5Fe_2(SO_4)_3 + K_2SO_4 + 2MnSO_4 + 8H_2O$

$$\frac{2KMnO_4}{10} = \frac{10FeSO_4}{10} = \frac{Fe_2O_3}{2} = \frac{Fe}{1}$$

(32) $2FeCl_3 + 2KI = 2KCl + 2FeCl_2 + I_2$

$$I = FeCl_3 = Fe = \frac{Fe_2O_3}{2}$$

Lead

(33) $2Pb(C_2H_3O_2)_2 + K_2Cr_2O_7 + H_2O = 2PbCrO_4 + 2KC_2H_3O_2 + 2HC_2H_3O_2$

$$\frac{2Pb}{4} = \frac{K_2Cr_2O_7}{4} \text{ (as precipitating agent for lead)}$$

(34) $2PbCrO_4 + 6KI + 16HCl = 2PbCl_2 + 6KCl + 2CrCl3 + 8H_2O + 3I_2$

$$I = \frac{PbCrO_4}{3} = \frac{Pb}{3} = \frac{K_2Cr_2O_7}{6}$$

VOLUMETRIC QUANTITATIVE REACTIONS WITH GRAM EQUIVALENTS (Continued)

Manganese

(35) $MnO_2 + H_2SO_4 + H_2C_2O_4 = MnSO_4 + CO_2 + 2H_2O$

$$\frac{2KMnO_4}{10} = \frac{C_2H_2O_4}{2} = \frac{MnO_2}{2} = \frac{Mn}{2}$$

(36) (Bismuthate Method)

(a) $2Mn(NO_3)_2 + 5NaBiO_3 + 16HNO_3 = 5NaNO_3 + 5Bi(NO_3)_3 + 7H_2O + 2HMnO_4$

(b) $2HMnO_4 + 5Na_3AsO_3 + 4HNO_3 = 5Na_3AsO_4 + Mn(NO_3)_2 + 3H_2O$

$$\frac{2HMnO_4}{10} = \frac{Na_3AsO_3}{2} = \frac{Mn}{5}$$

(37) (Persulfate Method)

(a) $2Mn(NO_3)_2 + 5(NH_4)_2S_2O_8 + 8H_2O = 5(NH_4)_2SO_4 + 4HNO_3 + 5H_2SO_4 + 2HMNO_4$

(b) $2HMnO_4 + 10FeSO_4 + 7H_2SO_4 = 5Fe_2(SO_4)_3 + 2MnSO_4 + 8H_2O$

$$\frac{2HMnO_4}{10} = \frac{10FeSO_4}{10} = \frac{Mn}{5}$$

(38) (Volhard's Method)

$3MnSO_4 + 2KMnO_4 + 2H_2O = 5MnO_2 + K_2SO_4 + 2H_2SO_4$ *OR*

$6MnSO_4 + 5ZnSO_4 + 4KMnO_4 + 14H_2O = 4KHSO_4 + 7H_2SO_4 + 5Zn(OH)_2.2MnO_2$

$$\frac{2KMnO_4}{10} = \frac{3MnSO_4}{10} = \frac{3Mn}{10}$$

(39) (Ford Williams Method)

$MnO_2 + 2FeSO_4 + 2H_2SO_4 = MnSO_4 + Fe_2(SO_4)_3 + 2H_2O$

$$\frac{2FeSO_4}{2} = \frac{MnO_2}{2} = \frac{Mn}{2}$$

Molybdenum

(40) (a) $2MoO_3 + Zn = Mo_2O_3 + 3ZnO$

(b) $5Mo_2O_3 + 6KMno_4 + 9H_2SO_4 = 10MoO_3 + 3K_2SO_4 + 6MnSO_4 + 9H_2O$

$$\frac{6KMnO_4}{30} = \frac{Mo_2O_3}{6} = \frac{MoO_3}{3} = \frac{Mo}{3}$$

Nickel (KCN Method)

(41) (a) $2NiSO_4 + 12NH_4OH = 2Ni(NH_3)_6SO_4 + 12H_2O$

(b) $Ni(NH_3)_6SO_4 + 4KCN = K_2Ni(CN)_4 + K_2SO_4 + 6NH_3$

$$\frac{4KCN}{8} = \frac{Ni(NH_3)_6SO_4}{8} = \frac{Ni}{8}$$

Oxygen

(42) $5H_2O_2 + 2KMnO_4 + 4H_2SO_4 = 2KHSO_4 + 2MnSO_4 + 8H_2O + 5O_2$

VOLUMETRIC QUANTITATIVE REACTIONS WITH GRAM EQUIVALENTS (Continued)

$$\frac{2KMnO_4}{10} = \frac{H_2O_2}{2}$$

Phosphorus

(43) (a) $H_3PO_4 + 12(NH_4)_2MoO_4 + 21HNO_3 = (NH_4)_3PO_4.12MoO_3 + 21(NH_4)_3NO_3 + 12H_2O$

(b) $2(NH_4)_3PO_4.12MoO_3 + 46NaOH + H_2O = 2(NH_4)_2HPO_4 + (NH_4)_2MoO_4 + 23Na_2MoO_4 + H_2O$

$$\frac{NaOH}{46} = \frac{2(NH_4)_3PO_4.12MoO_3}{46} = \frac{P_2O_5}{46} = \frac{P}{23}$$

(44) (a) $2(NH_4)_3PO_4.12MoO_3 + 46NH_4OH + H_2O = 24(NH_4)_2MoO_4 + 2(NH_4)_2HPO_4 + 23H_2O$

(b) $(NH_4)_2MoO_4 + H_2SO_4 = (NH_4)_2SO_4 + H_2MnO_4$

(c) $2MoO_3 + 3Zn + 3H_2SO_4 = 3ZnSO_4 + 3H_2O + Mo_2O_3$

(d) $5Mo_2O_3 + 6KMnO_4 + 9H_2SO_4 = 10MoO_3 + 3K_2SO_4 + 6MnSO_4 + 9H_2O$

$$\frac{6KMnO_4}{30} = \frac{Mo_2O_3}{6} = \frac{(NH_4)_3PO_4.12MoO_3}{36} = \frac{P}{36} = \frac{P_2O_5}{72}$$

(45) (No ferric alum present)
(a-b-c) as in Reaction 44
(d) $12Mo_2O_3 + O = Mo_{24}O_{37}$
(e) $Mo_{24}O_{37} + 14KMnO_4 + 21H_2SO_4 = 24MoO_3 + 7K_2SO_4 + 14MnSO_4 + 21H_2O$

$$\frac{14KMnO_4}{70} = \frac{Mo_{24}O_{37}}{70} = \frac{(NH_4)_3PO_4.12MoO_3}{35} = \frac{P}{35} = \frac{P_2O_5}{70}$$

Sulfur

(46) $H_2S + I_2 + 2HI + S$

$$I = \frac{H_2S}{2} = \frac{S}{2}$$

(47) $H_2SO_4 + 2NaOH = Na_2SO_4 + 2H_2O$

$$NaOH = \frac{Na_2SO_4}{2}$$

(48) $NaHSO_4 + NaOH = Na_2SO_4 + H_2O$

$$NaOH = NaHSO_4$$

(49) $Na_2SO_3 + I_2 - H_2O = Na_2SO_4 + 2HI$

$$I = \frac{Na_2SO_3}{2} = \frac{SO_2}{2} = \frac{S}{2}$$

(50) $2Na_2S_2O_3 + I_2 = Na_2S_4O_6 + 2NaI$

$$I = Na_2S_2O_3$$

VOLUMETRIC QUANTITATIVE REACTIONS WITH GRAM EQUIVALENTS (Continued)

Tin

(51) $SnCl_2 + I_2 + 2HCl = SnCl_4 + 2HI$

$$I = \frac{SnCl_2}{2} = \frac{Sn}{2}$$

Titanium

(52) (a) $Ti_2(SO_4)_3 + Fe_2(SO_4)_3 = 2Ti(SO_4)_2 + 2FeSO_4$

(b) $10FeSO_4 + KMnO_4 + 8H_2SO_4 = 5Fe_2(SO_4)_3 + K_2SO_4 + 2MnSO_4 + 8H_2O$

$$\frac{2KMnO_4}{10} = \frac{FeSO_4}{1} = \frac{Ti_2(SO_4)_3}{2} = \frac{Ti}{1}$$

Tungsten

(53) $WO_3 + 2NaOH = Na_2WO_4 + H_2O$

$$\frac{NaOH}{1} = \frac{WO_3}{2} = \frac{W}{2}$$

Uranium

(54) (a) $U_2O_3 + 4H_2SO_4 = 2UO_2SO_4 + U(SO_4)_2 + 4H_2O$

(b) $5U(SO_4)_2 + 2KMnO_4 + 2H_2O = 2KHSo_4 + 2MnSO_4 + H_2SO_4 + 5Uo_2SO$

$$\frac{2KMnO_4}{10} = \frac{U(SO_4)_2}{2} = \frac{UO_2}{2} = \frac{U}{2}$$

(c) $U_3O_8 = 2UO_3 + UO_2$

$$\frac{2KMnO_4}{10} = \frac{U_3O_8}{2} = \frac{3U}{2}$$

Vanadium

(55) (a) $V_2O_5 + SO_2 \rightleftarrows V_2O_4 + SO_3$

(b) $5V_2O_4 + 2KMnO_4 + 3H_2SO_4 = 5V_2O_5 + K_2SO_4 + 2MnSO_4 + 3H_2O$

$$\frac{2KMnO_4}{10} = \frac{V_2O_4}{2} = \frac{V_2O_5}{2} = \frac{V}{1}$$

(56) (a) $V_2O_5 + 3Zn + 3H_2SO_4 = V_2O_2 + 3H_2O + 3ZnSO$

(b) $V_2O_2 + Fe_2O_3 = 6FeO + V_2O_5$

(c) $10FeSO_4 + 2KMnO_4 + 8H_2SO_4 = 5Fe_2(SO_4)_3 + K_2SO_4 + 2MnSO_4 + 8H_2O$

$$\frac{2KMnO_4}{10} = \frac{FeSO_4}{1} = \frac{V_2O_5}{6} = \frac{V}{3}$$

57) (a) As in Reaction 56

(b) $5V_2O_2 + 6KMnO_4 + 9H_2SO_4 = 5V_2O_5 + 3K_2SO_4 + 6MnSO_4 + 9H_2O$

$$\frac{6KMnO_4}{30} = \frac{V_2O_5}{6} = \frac{V_2O_2}{6} = \frac{V}{3}$$

(58) $V_2O_5 + 2KI + 2HCl = V_2O_4 + 2KCl + H_2O + I_2$

$$I = \frac{V_2O_5}{2} = \frac{V}{1}$$

VOLUMETRIC QUANTITATIVE REACTIONS WITH GRAM EQUIVALENTS (Continued)

Zinc

(59) (a) $Fe_2(SO_4)_3 + Zn = ZnSO_4 + 2FeSO_4$

(b) $10FeSO_4 + 2KMnO_4 + 8H_2SO_4 = 5Fe_2(SO_4)_3 + K_2SO_4 + 2MnSO_4 + 8H_2O$

$$\frac{2KMnO_4}{10} = \frac{FeSO_4}{1} = \frac{Zn}{2}$$

(60) $3ZnCl_2 + 2K_4Fe(CN)_6 = K_2Zn_3(Fe(CN)_6)_2 + 6KCl$

$$K_4Fe(CN)_6 = \frac{3ZnCl_2}{2} = \frac{3Zn}{2}$$

SOLUBILITY CHART

	Acetate.	Arsenatc.	Arsenite.	Borate.	Bromide.	Carbonate.	Chlorate.	Chloride.	Chromate.	Cyanide.	Ferricyanide.	Ferrocyanide.	Fluoride.	Hydroxide.	Iodide.	Nitrate.	Oxalate.	Oxide.	Phosphate.	Silicate.	Sulphate.	Sulphide.	Tartrate.
Al.....	W	a	..	A	W	..	W	W	..	..	..	w	I	A	W	W	A	A	A	a	W	A	W
NH_4....	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	..	W	..	W	W	W
Sb.....	..	a	A	..	w	..	..	w	A	..	..	..	..	W	..	w	..	A	A	w	..	w	A
Ba.....	W	A	A	A	W	A	W	W	A	w	w	w	a	W	W	W	A	W	A	A	I	W	A
Bi.....	W	A	..	A	w	A	W	w	A	w	..	w	A	A	A	W	A	A	A	..	W	A	A
Cd.....	W	A	..	w	W	A	W	W	A	A	A	..	w	A	W	W	A	A	A	A	W	A	w
Ca.....	W	A	A	w	W	A	W	W	w	W	W	W	a	w	W	W	A	w	A	A	A	W	A
Cr.....	W	A	..	A	W	..	W	W	A	A	..	..	..	A	W	W	w	A	A	A	W	A	W
Co.....	W	A	A	A	W	A	W	W	A	a	I	I	w	A	W	W	A	A	A	A	W	A	W
Cu.....	W	A	A	W	W	A	W	W	W	A	I	I	A	A	W	W	A	A	A	A	W	A	W
Au.....	..	..	..	..	W	..	..	W	..	A	..	..	..	A	A	..	..	A	..	..	..	A	..
H.....	W	W	..	W	W	..	W	W	..	W	W	W	W	W	W	W	W	W	W	W	W	w	W
Fe''....	W	A	A	A	W	A	W	W	..	a	I	I	w	A	W	W	A	A	A	A	W	A	w
Fe'''...	W	A	A	A	W	..	W	W	W	..	W	I	W	A	W	W	A	A	A	A	W	A	W
Pb.....	W	A	A	A	a	A	W	a	a	A	w	A	A	A	w	W	A	A	A	A	a	A	A
Mg.....	W	A	A	w	W	A	W	W	W	W	W	a	A	W	W	W	A	A	A	A	W	A	W
Mn.....	W	A	A	A	W	A	W	W	W	W	I	A	A	A	W	W	w	A	A	A	W	A	w
Hg'.....	w	A	A	..	a	A	W	a	A	A	..	..	W	..	A	W	A	A	A	..	w	A	W
Hg''....	W	A	A	..	W	A	W	W	w	A	A	A	w	..	A	W	A	A	A	..	W	A	A
Ni.....	W	A	A	A	W	A	W	W	A	a	I	I	w	A	W	W	A	A	A	A	W	A	A
K.....	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W
Ag.....	w	A	A	I	A	W	I	A	I	I	I	W	..	I	W	A	A	A	..	w	W	A	A
Na.....	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W
Sn''''...	W	A	..	..	W	..	..	W	..	..	..	I	W	A	W	w	W	A	A	..	W	A	.
Sn''....	W	A	A	A	W	..	W	W	A	..	..	I	W	A	W	..	A	A	A	..	W	A	.
Sr.....	W	A	A	A	W	A	W	W	w	A	W	W	a	A	W	W	A	w	A	A	a	W	A
Zn.....	W	A	A	A	W	A	W	W	W	A	A	I	w	A	W	W	A	A	A	A	W	A	A

W Soluble in water.
A Insoluble in water but soluble in acids.
w Sparingly soluble in water but soluble in acids.
a Insoluble in water and only sparingly soluble in acids.
I Insoluble in both water and acids.

SOLUBILITY OF CANE SUGAR IN WATER

Grams of sugar in 100 grams of water, temperature in degrees Centigrade.

	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°	100
$C_{12}H_{22}O_{11}$.....	179.2	190.5	203.9	219.5	238.1	260.4	287.3	320.5	362.1	415.7	487

SOLUBILITY OF INORGANIC COMPOUNDS IN WATER

The table shows the number of grams of the anhydrous substance indicated in the first column which can be dissolved in 100 grams of water at the temperature in degrees Centigrade given at the top. When the formula is preceded by a * the solubility is stated in grams of anhydrous substance in 100 grams of saturated solution; when preceded by ** the solubility is stated in grams of anhydrous substance in 100 c.c. of the saturated solution. The column headed with S. P. shows the solid phase hydrated form in equilibrium with the saturated solution.

Substance	S. P.	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°	100°
Ag_3AsO_3	.....	.....	.....	1.15×10^{-5}	.....	.....	.....	.....	.....	.....	.....	.....
Ag_3AsO_4	.....	.....	.....	8.5×10^{-4}	.....	.....	.....	.....	.....	.....	.....	.....
AgBr	.....	.....	.....	8.4×10^{-6}	.....	.....	.....	.....	.....	.....	.....	.....
$AgC_2H_3O_2$	.....	0.72	0.88	1.04	1.21	1.41	1.64	1.89	2.18	2.52	.....	.....
AgCl	.....	.....	8.9×10^{-5}	1.5×10^{-4}	.....	.....	5.23×10^{-4}	.....	.....	.....	.....	2.1×10^{-3}
AgCN	.....	.....	.....	2.2×10^{-5}	.....	.....	.....	.....	.....	.....	.....	.....
Ag_2CO_3	.....	.....	.....	3.2×10^{-3}	.....	.....	.....	.....	.....	.....	.....	5×10^{-2}
Ag_2CrO_4	.....	1.4×10^{-3}	.....	.....	3.6×10^{-3}	.....	5.3×10^{-3}	.....	8×10^{-3}	.....	.....	.....
$Ag_3Fe(CN)_6$	.....	.....	.....	6.6×10^{-5}	.....	.....	.....	.....	.....	.....	.....	.....
AgI	.....	.....	.....	.....	3×10^{-7}	.....	.....	3×10^{-6}	.....	.....	.....	.....
$AgIO_3$	.....	.....	3×10^{-3}	4×10^{-3}	.....	.....	.....	1.9×10^{-2}	.....	.....	.....	.....
$AgNO_2$	.....	1.55×10^{-1}	2.29×10^{-1}	3.40×10^{-1}	5×10^{-1}	7.15×10^{-1}	9.95×10^{-1}	13.63×10^{-1}	.....	.....	.....	.....
$AgNO_3$	.....	122	170	222	300	376	455	525	.....	669	.....	952
Ag_2S	.....	.....	.....	1.4×10^{-5}	.....	.....	.....	.....	.....	.....	.....	.....
*Ag_2SO_4	.....	5.7×10^{-1}	6.9×10^{-1}	7.9×10^{-1}	8.8×10^{-1}	9.7×10^{-1}	10.7×10^{-1}	11.4×10^{-1}	12.1×10^{-1}	12.8×10^{-1}	13.4×10^{-1}	13.9×10^{-1}
*$AlCl_3$	.....	.....	41.13[15°]	.....	.....	.....	.....	.....	.....	.....	.....	.....
*$Al_2(SO_4)_3$	$18H_2O$	23.8	25.1	26.7	28.8	31.4	34.3	37.2	39.8	42.2	44.7	47.1
*As_2O_5	.....	37.3	38.3	39.7	41	41.6	.....	42.2	.....	42.9	.....	43.4
As_2S_3	.....	.....	.....	5.17×10^{-5}	at 18°	.....	.....	.....	.....	.....	.....	.....
B_2O_3	.....	1.1	1.5	2.2	.....	4.0	.....	6.2	.....	9.5	.....	15.7
$BaBr_2$	.....	98	101	104	109	114	118	123	128	135	.....	149
*$Ba(BrO_3)_2$	.....	2.85×10^{-1}	4.39×10^{-1}	6.52×10^{-1}	9.5×10^{-1}	13.1×10^{-1}	17.2×10^{-1}	22.71×10^{-1}	29.22×10^{-1}	35.21×10^{-1}	42.6×10^{-1}	54×10^{-1}
$Ba(C_2H_3O_2)_2$	$3H_2O$	59	63	71	.....	.....	.....	.....	.....	.....	.....	.....
$Ba(C_2H_3O_2)_2$	$1H_2O$	.....	.....	.....	75	79	77	74	74	.....	.....	75
$BaCl_2$	.....	31.6	33.3	35.7	38.2	40.7	43.6	46.4	49.4	52.4	.....	58.8
*$Ba(ClO_3)_2$	.....	16.90	21.33	25.26	29.43	33.16	.....	40.05	.....	45.90	.....	51.2

SOLUBILITY OF INORGANIC COMPOUNDS IN WATER (Continued)

Substance	S. P.	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°	100°
*$Ba(ClO_4)_2$	.....	67.3	.....	74.3	.....	78.2	.....	81	.....	83.2	.....	84.9
$BaCO_3$	.....	1.6×10^{-3}	at 8°; 2.2×10^{-3} at 18°;		2.4×10^{-3} a	t 24.2°	.....	.....	.....	.....	.....	.....
*BaC_2O_4	.....	5.8×10^{-3}	8.2×10^{-3}	.....	17×10^{-3}	.....	.....	.....	.....	.....	.....	.....
$BaCrO_4$	.....	2×10^{-4}	2.8×10^{-4}	3.7×10^{-4}	4.6×10^{-4}	.....	.....	.....	.....	.....	.....	.....
BaI_2	$6H_2O$	170.2	185.7	203.1	219.6	.....	.....	.....	.....	.....	.....	.....
BaI_2	$2H_2O$	.....	.....	.....	.....	231.9	.....	247.3	.....	261.0	.....	271.7
*$Ba(IO_3)_2$	.....	8×10^{-3}	1.4×10^{-2}	2.2×10^{-2}	3.1×10^{-2}	4.1×10^{-2}	5.6×10^{-2}	7.4×10^{-2}	9.3×10^{-2}	11.5×10^{-2}	14.1×10^{-2}	19.7×10^{-2}
$BaMoO_4$	.....	.....	5.8×10^{-3}	at 23°	.....	.....	.....	.....	.....	.....	.....	.....
*$Ba(NO_2)_2$	$1H_2O$	.....	.....	40.3	.....	.....	.....	.....	.....	67.3	.....	75
$Ba(NO_3)_2$	.....	5.0	7.0	9.2	11.6	14.2	17.1	20.3	.....	27.0	.....	34.2
$Ba(OH)_2$	.....	1.67	2.48	3.89	5.59	8.22	13.12	20.94	.....	101.40	.....	.....
$BaSO_4$	.....	1.15×10^{-4}	2.0×10^{-4}	2.4×10^{-4}	2.85×10^{-4}	.....	.....	.....	.....	.....	.....	.....
$BeKF_3$	.....	.....	.....	2.0	.....	.....	.....	.....	.....	.....	.....	5.2
$BeNaF_3$	.....	.....	.....	1.4	.....	.....	.....	.....	.....	.....	.....	2.8
$BeSO_4$	$6H_2O$	.....	.....	.....	52	.....	60.67	.....	.....	.....	.....	.....
$BeSO_4$	$4H_2O$	.....	.....	43.78	46.74	.....	.....	62	.....	83	.....	100
$BeSO_4$	$2H_2O$	.....	.....	.....	.....	.....	.....	.....	.....	84.76	98	110
Br_2	.....	4.22	3.4	3.20	3.13	.....	.....	.....	.....	.....	.....	.....
Bi_2S_3	.....	.....	1.8×10^{-5}	at 18°	.....	.....	.....	.....	.....	.....	.....	.....
$CaBr_2$	$6H_2O$	125	132	143	.....	.....	.....	.....	.....	.....	.....	.....
$CaBr_2$	$4H_2O$	.....	.....	.....	.....	68.1	.....	73.5	.....	74.7	.....	.....
$Ca(C_2H_3O_2)_2$	$2H_2O$	37.4	36.0	34.7	33.8	33.2	.....	32.7	.....	33.5	.....	.....
$Ca(C_2H_3O_2)_2$	H_2O	.....	.....	.....	.....	.....	.....	.....	.....	.....	31.1	29.7
$CaCl_2$	$6H_2O$	59.5	65.0	74.5	102	.....	.....	.....	.....	.....	.....	.....
$CaCl_2$	$2H_2O$	.....	.....	.....	.....	.....	.....	136.8	141.7	147.0	152.7	159
CaC_2O_4	.....	6.7×10^{-4}	at 13°; 6.8×10^{-4} at 2		5°; 9.5×10^{-4} at 50°;		4.0×10^{-4} a	t 95°	.....	.....	.....	.....
CaF_2	.....	1.6×10^{-3}	at 18°; 1.7×10^{-3} at 2		6°	.....	.....	.....	.....	.....	.....	.....
$Ca(HCO_3)_2$	.....	16.15	.....	16.60	.....	17.05	.....	17.50	.....	17.95	.....	18.40
*CaI_2	.....	64.6	66.0	67.6	69	70.8	.....	74	.....	78	.....	81
*$Ca(IO_3)_2$	$6H_2O$	0.10	0.17	.....	0.42	0.61	0 89	1.36	.....	.....	.....	.....
*$Ca(IO_3)_2$	$1H_2O$	.....	.....	.....	.....	0.52	0.59	0.65	.....	0.79	.....	0.94

SOLUBILITY OF INORGANIC COMPOUNDS IN WATER (Continued)

Substance	S. P.	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°	100°
*$Ca(NO_2)_2$	$4H_2O$	38.3	.....	43.4	.....	.....	.....	.....	.....	.....	.....	.....
*$Ca(NO_2)_2$	$2H_2O$	.....	.....	.....	.....	.....	.....	57	60.3	.....	71	.....
*$Ca(NO_3)_2$	$4H_2O$	50.50	53.55	56.39	60.41	66.21	.....	.....	.....	.....	.....	.....
*$Ca(NO_3)_2$	$3H_2O$	.....	.....	.....	.....	70.37	73.79	.....	.....	.....	.....	.....
*$Ca(NO_3)_2$	.....	.....	.....	.....	.....	.....	.....	.....	.....	78.2	.....	78.43
$Ca(OH)_2$	.....	1.85×10^{-1}	1.76×10^{-1}	1.65×10^{-1}	1.53×10^{-1}	1.41×10^{-1}	1.28×10^{-1}	1.16×10^{-1}	1.06×10^{-1}	9.4×10^{-2}	8.5×10^{-2}	7.7×10^{-2}
$CaSO_4$	.....	1.759×10^{-1}	1.928×10^{-1}	.....	2.09×10^{-1}	.....	2.097×10^{-1}	2.047×10^{-1}	1.974×10^{-1}	.....	.....	1.619×10^{-1}
*$CdBr_2$	.....	37.92	.....	.....	56.90	60.65	.....	61.10	.....	62.29	.....	.....
*$CdCl_2$	$4H_2O$	49.39	55.58	.....	.....	.....	.....	.....	.....	.....	.....	.....
*$CdCl_2$	$2\frac{1}{2}H_2O$	47.37	.....	.....	56.91	.....	.....	.....	.....	.....	.....	.....
*$CdCl_2$	H_2O	.....	57.47	57.35	.....	57.51	.....	57.71	.....	58.41	.....	59.52
$Cd(CN)_2$	.....	.....	$1.71^{15°}$	.....	.....	.....	.....	.....	.....	.....	.....	.....
CdI_2	.....	79.8	83.2	86.2	89.7	93.8	97.4	.....	.....	.....	.....	127.6
$Cd(OH)_2$	.....	.....	2.6×10^{-4}	at 25°	.....	.....	.....	.....	.....	.....	.....	.....
CdS	.....	.....	9×10^{-7}	at 18°	.....	.....	.....	.....	.....	.....	.....	.....
*$Ce_2(SO_4)_3$	$9H_2O$	17.35	.....	9.16	6.36	.....	4.465	3.73	.....	.....	.....	.....
*$Ce_2(SO_4)_3$	$8H_2O$	15.95	.....	8.69	.....	5.613	.....	3.88	.....	.....	.....	.....
*$Ce_2(SO_4)_3$	$5H_2O$	.....	.....	.....	.....	.....	.....	3.145	.....	1.19	.....	0.46
*$Ce_2(SO_4)_3$	$4H_2O$	.....	.....	.....	.....	5.71	3.31	2.3	.....	1.0	.....	0.42
Cl_2 760mm.	.....	1.46	0.980	0.716	0.562	0.451	0.386	0.324	0.274	0.219	0.125	0
CO 760mm.	.....	4.4×10^{-3}	3.5×10^{-3}	2.8×10^{-3}	2.4×10^{-3}	2.1×10^{-3}	1.8×10^{-3}	1.5×10^{-3}	1.3×10^{-3}	1.0×10^{-3}	6×10^{-4}	0
CO_2 760mm.	.....	0.3346	0.2318	0.1688	0.1257	0.0973	0.0761	0.0576	.....	.....	.....	.....
*$CoCl_2$	$6H_2O$	29.5	31.5	33.5	35.5	.....	.....	.....	.....	.....	.....	.....
*$CoCl_2$	H_2O	.....	.....	.....	.....	41.0	47.0	47.5	.....	49.5	.....	51.0
*CoI_2	.....	58.0	61.5	65.2	70.0	75.0	79.0	.....	.....	80.0	.....	.....
*$Co(NO_3)_2$	$6H_2O$	45.66	.....	50	.....	55.9	.....	.....	.....	.....	.....	.....
*$Co(NO_3)_2$	$3H_2O$	.....	.....	.....	.....	.....	.....	62	64.89	68	77	.....
CoS	.....	3.79×10^{-4}	at 18°	.....	.....	.....	.....	.....	.....	.....	.....	.....
$CoSO_4$	.....	25.55	30.55	36.21	42.26	48.85	55.2	60.4	65.7	70	.....	83
*CrO_3	.....	62.24	.....	.....	.....	63.50	64.55	.....	.....	.....	68.5	67.4
CsCl	.....	161.4	174.7	186.5	197.3	208.0	218.5	229.7	239.5	250.0	260.1	270.5

SOLUBILITY OF INORGANIC COMPOUNDS IN WATER (Continued)

Substance	S. P.	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°	100°
$CsClO_3$	.....	2.46	3.8	6.2	9.5	13.8	19.4	26.2	34.7	45.0	58.0	79.0
$CsClO_4$	.....	0.8	1.0	1.6	2.6	4.0	5.4	7.3	9.8	14.4	20.5	30.0
CsF	$1\frac{1}{2}H_2O$	.....	.....	$366.6^{18°}$	.....	.....	.....	.....	.....	.....	.....	.....
$CsIO_3$	.....	.....	.....	$2.6^{24°}$	.....	.....	.....	.....	.....	.....	.....	.....
$CsIO_4$	.....	.....	.....	$2.15^{15°}$	.....	.....	.....	.....	.....	.....	.....	.....
$CsNO_3$	.....	9.33	14.9	23.0	33.9	47.2	64.4	83.8	107.0	134.0	163.0	197.0
*CsOH	.....	.....	.....	$79.41^{15°}$	.....	.....	.....	.....	.....	.....	.....	.....
Cs_2SO_4	.....	167.1	173.1	178.7	184.1	189.9	194.9	199.9	205.0	210.3	214.9	220.3
CuCl	.....	.....	.....	$1.52^{25°}$	.....	.....	.....	.....	.....	.....	.....	.....
*$CuCl_2$	.....	41.4	42.45	43.5	44.55	45.6	46.65	47.7	.....	49.8	.....	51.9
CuI_2	.....	.....	.....	1.107	.....	.....	.....	.....	.....	.....	.....	.....
*$Cu(NO_3)_2$	$6H_2O$	45	48.79	55.58	.....	.....	.....	.....	.....	.....	.....	.....
*$Cu(NO_3)_2$	$3H_2O$	.....	.....	.....	.....	61.51	.....	64.17	.....	67.51	.....	.....
CuS	.....	.....	3.3×10^{-5}	at 18°	.....	.....	.....	.....	.....	.....	.....	.....
$CuSO_4$	.....	14.3	17.4	20.7	25	28.5	33.3	40	.....	55	.....	75.4
*$FeBr_2$	.....	50.5	.....	53.5	55.0	56.2	.....	59.0	.....	61.5	.....	64.0
*$FeCl_2$	$4H_2O$	.....	39.2	.....	42.2	43.6	45.2	47.0	.....	50.0	.....	.....
*$FeCl_2$	H_2O	.....	.....	.....	.....	.....	.....	.....	.....	.....	51.3	51.4
$FeCl_3$	.....	74.4	81.9	91.8	.....	.....	315.1	.....	.....	525.8	.....	535.7
*$Fe(NO_3)_2$	$6H_2O$	41.53	.....	45.6	.....	.....	.....	62.5	.....	.....	.....	.....
FeS	.....	6.16×10^{-4}	at 18°	.....	.....	.....	.....	.....	.....	.....	.....	.....
$FeSO_4$	$7H_2O$	15.65	20.51	26.5	32.9	40.2	48.6	.....	.....	.....	.....	.....
$FeSO_4$	H_2O	.....	.....	.....	.....	.....	.....	.....	50.9	43.6	37.3	.....
*H_3BO_3	.....	2.59	3.45	4.8	6.30	8.02	10.35	12.90	15.70	19.11	23.30	28.7
HBr 760mm.	.....	221.2	210.3	198	.....	.....	171.5	.....	.....	.....	.....	130
HCl 760mm.	.....	82.3	.....	.....	67.3	63.3	59.6	56.1	.....	.....	.....	.....
*H_2SeO_3	.....	47.4	55	62.5	70.2	77.5	79.2	79.3	79.3	79.3	79.4	.....
H_2SeO_4	H_2O	81	.....	85	.....	.....	.....	.....	.....	.....	.....	.....
H_2SeO_4	.....	.....	.....	.....	93	94.5	96.5	100	.....	.....	.....	.....
*H_2TeO_4	$6H_2O$	13.92	26.21	.....	.....	.....	.....	.....	.....	.....	.....	.....
*H_2TeO_4	$2H_2O$	.....	25.29	.....	33.36	36.38	.....	43.67	.....	51.55	.....	60.84

SOLUBILITY OF INORGANIC COMPOUNDS IN WATER (Continued)

Substance	S. P.	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°	100°
HgBr	.....	.....	3.9×10^{-6}	at 25°	.....	.....	.....	.....	.....	.....	.....	.....
$HgBr_2$	.....	.....	.....	0.5	.....	.....	.....	.....	.....	.....	.....	25
*HgCl	.....	1.4×10^{-4}	.....	2×10^{-4}	7×10^{-4}	.....	.....	.....	.....	.....	.....	.....
*$HgCl_2$	.....	3.5	4.6	6.1	7.7	9.3	.....	14	.....	23.1	.....	38
$Hg(CN)_2$	.....		$9.3^{13.5°}_{\frac{1}{2}}$	$53.85^{101.1°}$	.....	.....	.....	.....	.....	.....	.....	.....
HgI	.....	.....	2×10^{-3}	at 25°	.....	.....	.....	.....	.....	.....	.....	.....
HgI_2	.....	.....	5.91×10^{-3}	at 25°	.....	.....	.....	.....	.....	.....	.....	.....
I_2	.....	.....	.....	2.9×10^{-4}	4.0×10^{-3}	5.6×10^{-2}	7.8×10^{-2}	.....	.....	.....	.....	.....
KBr	.....	53.5	59.5	65.2	70.6	75.5	80.2	85.5	90.0	95.0	99.2	104.0
$KBrO_3$	.....	3.1	4.8	6.9	9.5	13.2	17.5	22.7	.....	34.0	.....	50.0
$KC_2H_3O_2$	$1\frac{1}{2}H_2O$	216.7	233.9	255.6	283.8	323.3	.....	.....	.....	.....	.....	.....
$KC_2H_3O_2$	$\frac{1}{2}H_2O$	.....	.....	.....	.....	.....	337.3	350	364.8	380.1	396.3	.....
KCl	.....	27.6	31.0	34.0	37.0	40.0	42.6	45.5	48.3	51.1	54.0	56.7
$KClO_3$	.....	3.3	5	7.4	10.5	14	19.3	24.5	.....	38.5	.....	57
$KClO_4$	.....	0.75	1.05	1.80	2.6	4.4	6.5	9	11.8	14.8	18	21.8
*KCNS	....	63.9	.....	68.5	.....	.....	.....	.....	.....	.....	.....	.....
*K_2CO_3	$2H_2O$	51.3	52	52.5	53.2	53.9	54.8	55.9	57.1	58.3	59.6	60.9
K_2CrO_4	....	58.2	60.0	61.7	63.4	65.2	66.8	68.6	70.4	72.1	73.9	75.6
$K_2Cr_2O_7$	....	5	7	12	20	26	34	43	52	61	70	80
*$KHC_4H_4O_6$	....	0.32	0.40	0.53	0.9	1.3	1.8	2.4	.....	4.4	.....	6.5
*$KHCO_3$	....	18.3	21.7	24.9	28.1	31.2	.....	37.5	.....	.....	.....	.....
$KHSO_4$	....	36.3	.....	51.4	.....	67.3	.....	.....	.....	.....	.....	121.6
KI	.....	127.5	136	144	152	160	168	176	184	192	200	208
KIO_3	.....	4.73	.....	8.13	11.73	12.8	.....	18.5	.....	24.8	.....	32.2
$KMnO_4$	.....	2.83	4.4	6.4	9.0	12.56	16.89	22.2	.....	.....	.....	.....
*KNO_2	....	73.6	.....	74.9	.....	77	.....	.....	.....	.....	.....	80.5
KNO_3	.....	13.3	20.9	31.6	45.8	63.9	85.5	110.0	138	169	202	246
KOH	.....	2H_2O	97	103	112	126	.....	.....	.....	.....	.....	.....
KOH	.....	H_2O	.....	.....	.....	.....	140	.....	.....	.....	.....	178
K_2PtCl_6	.....	0.74	0.90	1.12	1.41	1.76	2.17	2.64	3.19	3.79	4.45	5.18
K_2SO_4	.....	7.35	9.22	11.11	12.97	14.76	16.50	18.17	19.75	21.4	22.8	24.1

SOLUBILITY OF INORGANIC COMPOUNDS IN WATER (Continued)

Substance	S. P.	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°	100°
**$K_2S_2O_8$		1.62	2.60	4.49	7.19	9.89						
$K_2SO_4.Al_2(SO_4)_3$	$24H_2O$	3.0	4.0	5.9	8.39	11.70	17.00	24.75	40.0	71.0	109.0	
$La_2(SO_4)_3$		3			1.9		1.5					0.69
LiBr	H_2O						214	224		245		266
LiBr	$2H_2O$	143	166	177	191	205						
LiCl		67	72	78.5	84.5	90.5	97	103		115		127.5
Li_2CO_3		1.54	1.43	1.33	1.25	1.17	1.08	1.01		0.85		0.72
LiI	$3H_2O$	151	157	165	171	179	187	202	230			
LiI	H_2O									435		481
*$LiNO_3$	$3H_2O$	34.8	37.9		57							
*$LiNO_3$	$1\frac{1}{2}H_2O$						61	63.6				
*$LiNO_3$									66			
LiOH		12.7	12.7	12.8	12.9	13	13.3	13.8		15.3		17.5
*Li_2SO_4		26.1	25.9	25.5	25.1	24.7	24.5	24.2		23.5		23
$MgBr_2$	$6H_2O$	91.0	94.5	96.5	99.2	101.6	104.1	107.5		113.7		120.2
$MgCl_2$	$6H_2O$	52.8	53.5	54.5		57.5		61.0		66.0		73.0
*MgI_2	$8H_2O$	54.7		58.3		63.4						
*$Mg(NO_3)_2$	$6H_2O$										65	
$Mg(OH)_2$			9×10^{-4} at 18°									
*$MgSO_4$	$7H_2O$		23.6	26.2	29	31.3						
*$MgSO_4$	$6H_2O$	29	29.7	30.8	31.2		33.5	35.5	37.3	39.1	40.8	42.5
*$MgSO_4$	H_2O									38.6		40.6
*$MnBr_2$	$4H_2O$	56.0	57.6	59.5	61.1	62.8	64.5	66.3	68.0			
*$MnBr_2$	$2H_2O$									69.2	69.3	69.5
$MnCl_2$	$4H_2O$	63.4	68.1	73.9	80.71	88.59	98.15					
$MnCl_2$	$2H_2O$							108.6	110.6	112.7	114.1	115.3
*$Mn(NO_3)_2$	$6H_2O$	50.49	54.1	58.8								
*$Mn(NO_3)_2$	$3H_2O$				67.38							
MnS			6.23×10^{-4}	at 18°								
$MnSO_4$	$7H_2O$	53.23	60.01									

Substance	S. P.	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°	100°
$MnSO_4$	$5H_2O$	.....	59.5	62.9	67.76	.....	.....	.....	.....	.....	.....	.....
$MnSO_4$	$4H_2O$	.....	.....	64.5	66.44	68.8	72.6	.....	.....	.....	.....	.....
$MnSO_4$	H_2O	.....	.....	.....	.....	.....	58.17	55.0	52.0	48.0	42.5	34.0
MoO_3	.....	.....	.....	0.138	0.264	0.476	0.687	1.206	2.055	2.106	.....	.....
N_2O	.....	.....	0.1705	0.1211	.....	.....	.....	.....	.....	.....	.....	.....
NH_4Br	.....	60.6	68	75.5	83.2	91.1	99.2	107.8	116.8	126	135.6	145.6
*NH_4CNS	.....	54.5	59	63	67.5	.....	.....	.....	.....	.....	.....	.....
*$(NH_4)_2C_2O_4$	.....	2.1	3	4.2	5.6	7.4	9.3	.....	.....	.....	.....	.....
$(NH_4)_2Cd(SO_4)_2$	.....	.....	.....	$72.3^{25°}$	.....	.....	.....	.....	.....	.....	.....	.....
NH_4Cl	.....	29.4	33.3	37.2	41.4	45.8	50.4	55.2	60.2	65.6	71.3	77.3
**NH_4ClO_4	.....	11.56	.....	20.85	.....	30.58	.....	39.05	.....	48.19	.....	57.01
$(NH_4)_2CoSO_4$	.....	6.0	9.5	13.0	17.0	22.0	27.0	33.5	40.0	49.0	.....	.....
*$(NH_4)_2CrO_4$	.....	.....	.....	.....	28.8	.....	.....	.....	.....	.....	.....	.....
*$(NH_4)_2Cr_2O_7$	.....	.....	.....	.....	32.05	.....	.....	.....	.....	.....	.....	.....
$(NH_4)_2Cr_2(SO_4)_4$	.....	.....	.....	$10.78^{25°}$	.....	.....	.....	.....	.....	.....	.....	.....
$(NH_4)_2Fe(SO_4)_2$	.....	12.5	17.2	.....	.....	33.0	40	.....	52	.....	.....	.....
$(NH_4)_2Fe_2(SO_4)_4$	.....	.....	.....	$44.15^{25°}$	.....	.....	.....	.....	.....	.....	.....	.....
NH_4HCO_3	.....	11.9	15.8	21	27	.....	.....	.....	.....	.....	.....	.....
$NH_4H_2PO_3$	.....	171	$190^{14.5°}$	$260^{31°}$	.....	.....	.....	.....	.....	.....	.....	.....
$(NH_4)_2HPO_4$	.....	.....	$131^{15°}$	.....	.....	.....	.....	.....	.....	.....	.....	.....
NH_4I	.....	154.2	163.2	172.3	181.4	190.5	199.6	208.9	218.7	228.8	.....	250.3
*NH_4LiSO_4	.....	.....	35.58	.....	35.87	.....	36.00	.....	36.18	.....	.....	.....
NH_4MgPO_4	.....	0.023	.....	0.052	.....	0.036	0.030	0.040	0.016	0.019	.....	.....
NH_4MnPO_4	.....	.....	.....	0	.....	0	.....	0	0.005	0.007	.....	.....
NH_4NO_3	.....	118.3	.....	192	241.8	297.0	344.0	421.0	499.0	580.0	740.0	871.0
$(NH_4)_2PtCl_6$	.....	.....	0.7	.....	.....	.....	.....	.....	.....	.....	.....	1.25
$(NH_4)_2SO_4$	.....	70.6	73.0	75.4	78.0	81.0	.....	88.0	.....	95.3	.....	103.3

SOLUBILITY OF INORGANIC COMPOUNDS IN WATER (Continued)

Substance	S. P.	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°	100°
$(NH_4)_2SO_4$. $Al_2(SO_4)_3$	$24H_2O$	2.10	4.99	7.74	10.94	14.88	20.10	26.70	.....	.....	.....	.....
$(NH_4)_2S_2O_8$	.....	58.2	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
*$(NH_4)_3SbS_4$	.....	41.6	.....	47.7	54.5	.....	.....	.....	.....	.....	.....	.....
$(NH_4)_2SeO_4$	.....	.....	1.22[12°]	.....	.....	.....	.....	.....	.....	.....	.....	.....
NH_4VO_3	.....	.....	.....	4.8	8.4	13.2	17.8	.....	30.5	.....	.....	.....
NO 760mm.	.....	9.84×10^{-3}	7.57×10^{-3}	6.18×10^{-3}	5.17×10^{-3}	1.40×10^{-3}	3.76×10^{-3}	3.24×10^{-3}	2.67×10^{-3}	1.99×10^{-3}	1.14×10^{-3}	0
N_2O 760mm.	.....	.....	0.171	0.121	.....	.....	.....	.....	.....	.....	.....	.....
*NaBr	$2H_2O$	44.3	.....	47.5	49.4	51.4	53.7	.....	.....	.....	.....	.....
*NaBr	.....	.....	.....	.....	.....	.....	.....	.....	.....	54.2	.....	54.8
$Na_2B_4O_7$	$10H_2O$	1.3	1.6	2.7	3.9	.....	10.5	20.3	.....	.....	.....	.....
$Na_2B_4O_7$	$5H_2O$	.....	.....	.....	.....	.....	.....	.....	24.4	31.5	41	52.5
$NaBrO_3$	.....	27.5	.....	34.5	.....	50.2	.....	62.5	.....	75.7	.....	90.9
$NaC_2H_3O_2$	$3H_2O$	36.3	49.8	46.5	54.5	65.5	83	139	.....	.....	.....	.....
$NaC_2H_3O_2$	.....	119	121	123.5	126	129.5	134	139.5	146	153	161	170
$Na_2C_2O_4$	.....	.....	.....	3.7	.....	.....	.....	.....	.....	.....	.....	6.33
NaCl	.....	35.7	35.8	36.0	36.3	36.6	37.0	37.3	37.8	38.4	39.0	39.8
$NaClO_3$	.....	79	89	101	113	126	140	155	172	189	.....	230
Na_2CO_3	$10H_2O$	7	12.5	21.5	38.8	.....	.....	.....	.....	.....	.....	.....
Na_2CO_3	H_2O	.....	.....	.....	50.5	48.5	.....	46.4	.....	45.8	.....	45.5
*Na_2CrO_4	$10H_2O$	24.07	33.41	47	.....	.....	.....	.....	.....	.....	.....	.....
*Na_2CrO_4	$4H_2O$	.....	.....	.....	47	48.97	51	53.4	.....	.....	.....	.....
*Na_2CrO_4	.....	.....	.....	.....	.....	.....	.....	.....	55.15	55.53	.....	55.74
*$Na_2Cr_2O_7$	$2H_2O$	61.98	.....	64	.....	.....	71	.....	76	79	.....	.....
$Na_2Cr_2O_7$	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	81
$Na_4Fe(CN)_6$	.....	.....	.....	17.9	.....	30	.....	.....	.....	59	.....	63
$NaHCO_3$	.....	6.9	8.15	9.6	11.1	12.7	14.45	16.4	.....	.....	.....	.....
NaH_2PO_4	$2H_2O$	57.9	69.9	85.2	106.5	138.2	.....	.....	.....	.....	.....	.....
NaH_2PO_4	H_2O	.....	.....	.....	.....	.....	153.6	.....	.....	.....	.....	.....
NaH_2PO_4	.....	.....	.....	.....	.....	.....	.....	179.3	190.3	207.3	225.3	246.6
Na_2HAsO_4	.....	7.3	15.5	26.5	37	47	.....	65	.....	85	.....	.....

Substance	S. P.	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°	100°
Na_2HPO_4	$12H_2O$	1.67	3.6	7.7	20.8	.....	.....	.....	.....	.....	.....	.....
Na_2HPO_4	$7H_2O$	.....	.....	.....	.....	51.8	.....	.....	.....	.....	.....	.....
Na_2YPO_4	$2H_2O$	.....	.....	.....	.....	.....	80.2	82.9	88.1	92.4	102.9	.....
Na_2HPO_4	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	102.2
NaI	.....	.....	.....	.....	.....	.....	.....	.....	294	296	.....	302
NaI	$2H_2O$	158.7	168.6	178.7	190.3	205.0	227.8	256.8	.....	.....	.....	.....
$NaIO_3$	.....	2.5	.....	9	.....	15	.....	21	.....	27	.....	34
*$NaNO_2$	.....	41.9	43.8	45.8	47.8	49.6	51	.....	.....	57	.....	62
$NaNO_3$	.....	73	80	88	96	104	114	124	.....	148	.....	180
NaOH	$4H_2O$	42	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
NaOH	$3\frac{1}{2}H_2O$	.....	51.5	.....	.....	.....	.....	.....	.....	.....	.....	.....
NaOH	H_2O	.....	.....	109	119	129	145	174	.....	.....	.....	.....
NaOH	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	313	347
Na_3PO_4	$12H_2O$	1.5	4.1	11	20	31	43	55	.....	81	.....	108
$Na_4P_2O_7$	$10H_2O$	3.16	3.95	6.23	9.95	13.50	17.45	21.83	.....	30.04	.....	40.26
*Na_2S	$9H_2O$	.....	13.36	15.8	18.4	22.2	.....	.....	.....	.....	.....	.....
*Na_2S	$5\frac{1}{2}H_2O$	.....	.....	.....	.....	.....	28.48	29.92	31.38	33.95	37.20	.....
*Na_2S	$6H_2O$	.....	.....	.....	.....	.....	26.7	28.1	30.22	32.95	36.42	.....
Na_2SO_3	$7H_2O$	13.9	20	26.9	36	.....	.....	.....	.....	.....	.....	.....
Na_2SO_3	.....	.....	.....	.....	.....	28.0	28.2	28.8	.....	28.3	.....	.....
Na_2SO_4	$10H_2O$	5.0	9.0	19.4	40.8	.....	.....	.....	.....	.....	.....	.....
Na_2SO_4	$7H_2O$	19.5	30	44	.....	.....	.....	.....	.....	.....	.....	.....
Na_2SO_4	.....	.....	.....	.....	.....	48.8	46.7	45.3	.....	43.7	.....	42.5
$Na_2S_2O_3$	.....	52.5	61.0	70.0	84.7	102.6	169.7	206.7	.....	248.8	254.2	266.0
*Na_2SeO_4	$10H_2O$	11.74	.....	.....	44.05	.....	.....	.....	.....	.....	.....	.....
*Na_2SeO_4	.....	.....	.....	.....	.....	.....	44.49	.....	.....	.....	.....	42.14
$NaVO_3$	$2H_2O$	.....	.....	.....	.....	30.2	.....	68.4	.....	.....	.....	.....
$NaVO_3$	.....	.....	.....	.....	.....	26.23	.....	32.97	36.9	.....	.....	.....
*Na_2WO_4	$10H_2O$	36.54	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
*Na_2WO_4	$2H_2O$	41.73	.....	42	.....	.....	.....	.....	.....	47.7	.....	49.3
$Nd_2(SO_4)_3$	.....	9.5	.....	.....	5	.....	3.7	.....	.....	2.7	.....	.....

SOLUBILITY OF INORGANIC COMPOUNDS IN WATER (Continued)

Substance	S. P.	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°	100°
*$NiBr_2$	.....	53	55	56.7	58	59.1	60	60.4	.....	60.6	.....	60.8
$NiCO_3$	.....	.....	9.25×10^{-3} at 25°	.....	.....	.....	.....	.....	.....	.....	.....	.....
*$NiCl_2$	.....	35	37.3	39.1	40.8	42.3	43.9	45.1	46	.....	.....	46.7
*NiI_2	.....	55.4	57.5	59.7	61.7	63.5	64.7	64.8	65	65.2	65.3	.....
*$Ni(NO_3)_2$	$6H_2O$	44.32	.....	49.06	.....	55	.....	.....	.....	.....	.....	.....
*$Ni(NO_3)_2$	$3H_2O$	.....	.....	.....	.....	.....	.....	61.99	63.95	.....	70.16	.....
NiS	.....	.....	3.6 × 10^{-4} at 18°	.....	.....	.....	.....	.....	.....	.....	.....	.....
$NiSO_4$	$7H_2O$	27.22	32	.....	42.46	.....	50.15	54.80	59.44	63.17	.....	76.7
$NiSO_4$	$6H_2O$	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
O_3	.....	3.9×10^{-3}	2.9×10^{-3}	2.1×10^{-3}	7×10^{-4}	4×10^{-4}	1×10^{-4}	0	.....	.....	.....	.....
$PbBr_2$	.....	0.4554	.....	0.85	1.15	1.53	1.94	2.36	.....	3.34	.....	4.75
$Pb(C_2H_3O_2)_2$	.....	.....	.....	55.04$^{25°}$	.....	.....	.....	.....	.....	.....	.....	.....
$PbCO_3$	.....	.....	.....	1.1×10^{-4}	.....	.....	.....	.....	.....	.....	.....	.....
$PbCl_2$	.....	0.6728	.....	0.99	1.20	1.45	1.70	1.98	.....	2.62	.....	3.34
$PbCrO_4$	.....	.....	.....	7×10^{-6}	.....	.....	.....	.....	.....	.....	.....	.....
PbF_2	.....	.....	0.06	0.064	0.068	.....	.....	.....	.....	.....	.....	.....
PbI_2	.....	0.0442	.....	0.068	0.090	0.125	0.164	0.197	.....	0.302	.....	0.436
$Pb(NO_3)_2$	.....	38.8	48.3	56.5	66	75	85	95	.....	115	.....	138.8
PbS	.....	.....	.....	8.6×10^{-5}	at 18°	.....	.....	.....	.....	.....	.....	.....
$PbSO_4$	.....	0.0028	0.0035	0.0041	0.0049	0.0056	.....	.....	.....	.....	.....	.....
RbCl	.....	77	84.4	91.1	97.6	103.5	109.3	115.5	121.4	127.2	133.1	138.9
$RbClO_3$	.....	2.14	.....	5.4	8	.....	15.98	.....	.....	.....	.....	62.8
$RbClO_4$	.....	0.5	0.6	1.0	1.5	2.3	3.5	4.85	6.72	9.2	12.7	18
$RbNO_3$	.....	19.5	33.0	53.3	81.3	116.7	155.6	200	251	309	375	452
Rb_2SO_4	.....	36.4	42.6	48.2	53.5	58.5	63.1	67.4	71.4	75.0	78.7	81.8
SO_2 760mm.	.....	22.83	16.21	11.29	7.81	5.41	4.5	.....	.....	.....	.....	.....
$SbCl_3$	.....	601.6		931.5	1068.0	1368.0	1917.0	4531.0	.....	∞	.....	.....
SbF_3	.....	384.7		444.7	563.6	.....	.....	.....	.....	.....	.....	.....
Sb_2S_3	.....	.....	1.75×	10^{-4} at 18°	.....	.....	.....	.....	.....	.....	.....	.....
$SnCl_2$	.....	83.9	269.8$^{15°}$	.....	.....	.....	.....	.....	.....	.....	.....	.....
SnI_2	.....	.....	.....	1.0	1.2	1.4	1.7	2.1	2.5	3.0	3.4	4.0

Substance	S. P.	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°	100°
$SnSO_4$	.....	.....	.....	19	.....	.....	.....	.....	.....	.....	.....	18
$SrBr_2$	.....	85.2	93	102.4	111.9	123.2	135.8	150	.....	181.8	.....	222.5
$Sr(C_2H_3O_2)_2$	$4H_2O$	36.9	43.61	.....	.....	.....	.....	.....	.....	.....	.....	.....
$Sr(C_2H_3O_2)_2$	$\frac{1}{2}H_2O$	.....	42.95	41.6	39.5	.....	37.35	.....	36.24	36.10	36.24	36.4
SrC_2O_4	.....	0.0033	0.0044	0.0040	0.0057	.....	.....	.....	.....	.....	.....	.....
$SrCl_2$	$6H_2O$	43.5	47.7	52.9	58.7	65.3	72.4	81.8	.....	.....	.....	.....
$SrCl_2$	$2H_2O$	.....	.....	.....	.....	.....	.....	.....	85.9	90.5	.....	100.8
SrI_2	$6H_2O$	165.3	.....	177.8	.....	191.5	.....	217.5	.....	270.4	.....	.....
SrI_2	$2H_2O$	.....	.....	.....	.....	.....	.....	.....	.....	.....	365.2	383.1
*$Sr(NO_2)_2$	H_2O	34.5	.....	39	.....	.....	45.6	49.3	.....	.....	56.6	58.1
$Sr(NO_3)_2$	$4H_2O$	40.1	.....	70.5	.....	.....	.....	.....	.....	.....	.....	.....
$Sr(NO_3)_2$	.....	.....	.....	.....	88.6	90.1	.....	93.8	96	98	100	.....
$SrSO_4$	.....	0.0113	.....	0.0114	0.0114	.....	.....	.....	.....	.....	.....	.....
$Th(SO_4)_2$	$9H_2O$	0.74	0.98	1.38	1.995	2.998	5.22	.....	.....	.....	.....	.....
$Th(SO_4)_2$	$8H_2O$	1.0	1.25	1.62	.....	.....	.....	.....	.....	.....	.....	.....
$Th(SO_4)_2$	$6H_2O$	1.50	.....	1.90	2.45	.....	.....	6.64	.....	.....	.....	.....
$Th(SO_4)_2$	$4H_2O$	.....	.....	.....	.....	4.04	2.54	1.63	1.09	.....	.....	.....
$Th(SeO_4)_2$	.....	0.498	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
TlBr	.....	0.024	0.029	0.042	.....	.....	.....	.....	.....	.....	.....	.....
$TlBrO_3$	.....	.....	.....	0.346	.....	0.736	.....	.....	.....	.....	.....	.....
TlCl	.....	0.21	0.25	0.33	0.42	0.52	0.63	0.8	.....	1.2	.....	1.8
$TlClO_3$	.....	2	.....	3.92	.....	.....	12.67	.....	.....	36.65	.....	57.31
$TlClO_4$	.....	6	8.04	.....	19.72	.....	39.62	.....	65.32	81.49	.....	166.6
TlI	.....	.....	0.0036	0.006	0.008	0.015	.....	0.035	.....	0.070	.....	0.120
$TlIO_3$	.....	.....	.....	0.058	.....	.....	.....	.....	.....	.....	.....	.....
$TlNO_3$	.....	3.91	6.22	9.55	14.3	20.9	30.4	46.2	69.5	111.0	200.0	414.0
TlOH	.....	25.44	.....	.....	39.9	49.5	.....	73.8	.....	106	126.1	148.3
Tl_2S	.....	.....	.....	0.022	.....	.....	.....	.....	.....	.....	.....	.....
Tl_2SO_4	.....	2.70	3.70	4.87	6.16	.....	9.21	10.92	12.74	14.61	16.53	18.45
Tl_2SeO_4	.....	.....	2.13	2.8	.....	.....	.....	.....	.....	.....	.....	.....
*$UO_2(NO_2)_2$	$6H_2O$	49.5	52	55.7	.....	.....	67	.....	.....	.....	.....	.....

SOLUBILITY OF INORGANIC COMPOUNDS IN WATER (Continued)

Substance	S. P.	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°	100°
$Yb_2(SO_4)_3$ ..	.....	44.2	.....	38.4	.....	21.0	.....	10.4	7.22	6.92	5.83	4.67
*$ZnBr_2$	$2H_2O$	79.55	.....	81.7	84.08	.....	.....	.....	.....	.....	.....	.....
*$ZnBr_2$	.....	.....	.....	.....	.....	85.53	.....	86.08	.....	86.57	.....	87.05
*$Zn(ClO_3)_2$ ..	$6H_2O$	59.19	60.4	.....	.....	.....	.....	.....	.....	.....	.....	.....
*$Zn(ClO_3)_2$ ..	$4H_2O$	.....	.....	66.7	67.66	69.06	73.2	.....	.....	.....	.....	.....
*ZnI_2	$2H_2O$	81.16	82.06	82.9	.....	.....	.....	.....	.....	.....	.....	.....
*ZnI_2	.....	81.11	.....	.....	.....	81.66	.....	82.37	.....	83.05	.....	83.62
*$Zn(NO_3)_2$ ..	$6H_2O$	48.66	.....	54.2	.....	.....	.....	.....	.....	.....	.....	.....
*$Zn(NO_3)_2$ ..	$3H_2O$	.....	.....	.....	.....	67.42	.....	.....	.....	.....	.....	.....
$ZnSO_4$	$7H_2O$	41.9	47	54.4	.....	.....	.....	.....	.....	.....	.....	.....
$ZnSO_4$	$6H_2O$	.....	.....	.....	.....	41.2	43.5	.....	.....	.....	.....	.....
$ZnSO_4$	.....	.....	.....	.....	.....	.....	.....	.....	.....	46.4	45.5	44.7

SOLUBILITY OF GASES IN WATER

SOLUBILITY OF

α, the absorption coefficient, is the volume of gas when reduced to 0° and 760 mm., absorbed by one volume of water when the pressure of the gas itself, without the aqueous tension, amounts to 760 mm.

q is the weight of gas in grams dissolved in 100 grams of water when the total pressure (i.e., the sum of the partial pressure of the gas plus the aqueous tension at the given temperature) is 760 mm.

Temp.° C	Nitrogen*		Oxygen		Hydrogen		Carbon Dioxide	
	α	q	α	q	α	q	α	q
0	0.02354	0.002942	0.04889	0.006945	0.02148	0.0001922	1.713	0.3346
1	0.02297	0.002869	0.04758	0.006756	0.02126	0.0001901	1.646	0.3213
2	0.02241	0.002798	0.04633	0.006574	0.02105	0.0001881	1.584	0.3091
3	0.02187	0.002730	0.04512	0.006400	0.02084	0.0001862	1.527	0.2978
4	0.02135	0.002663	0.04397	0.006232	0.02064	0.0001843	1.473	0.2871
5	0.02086	0.002600	0.04287	0.006072	0.02044	0.0001824	1.424	0.2774
6	0.02037	0.002537	0.04180	0.005918	0.02025	0.0001806	1.377	0.2681
7	0.01990	0.002477	0.04080	0.005773	0.02007	0.0001789	1.331	0.2589
8	0.01945	0.002419	0.03983	0.005632	0.01989	0.0001772	1.282	0.2492
9	0.01902	0.002365	0.03891	0.005498	0.01972	0.0001756	1.237	0.2403
10	0.01861	0.002312	0.03802	0.005368	0.01955	0.0001740	1.194	0.2318
11	0.01823	0.002263	0.03718	0.005246	0.01940	0.0001725	1.154	0.2239
12	0.01786	0.002216	0.03637	0.005128	0.01925	0.0001710	1.117	0.2165
13	0.01750	0.002170	0.03559	0.005014	0.01911	0.0001696	1.083	0.2098
14	0.01717	0.002126	0.03486	0.004906	0.01897	0.0001682	1.050	0.2032
15	0.01685	0.002085	0.03415	0.004802	0.01883	0.0001668	1.019	0.1970
16	0.01654	0.002045	0.03348	0.004703	0.01869	0.0001654	0.985	0.1903
17	0.01625	0.002006	0.03283	0.004606	0.01856	0.0001641	0.956	0.1845
18	0.01597	0.001970	0.03220	0.004514	0.01844	0.0001628	0.928	0.1789
19	0.01570	0.001935	0.03161	0.004426	0.01831	0.0001616	0.902	0.1737
20	0.01545	0.001901	0.03102	0.004339	0.01819	0.0001603	0.878	0.1688
21	0.01522	0.001869	0.03044	0.004252	0.01805	0.0001588	0.854	0.1640
22	0.01498	0.001838	0.02988	0.004169	0.01792	0.0001575	0.829	0.1590
23	0.01475	0.001809	0.02934	0.004087	0.01779	0.0001561	0.804	0.1540
24	0.01454	0.001780	0.02881	0.004007	0.01766	0.0001548	0.781	0.1493
25	0.01434	0.001751	0.02831	0.003931	0.01754	0.0001535	0.759	0.1449
26	0.01413	0.001724	0.02783	0.003857	0.01742	0.0001522	0.738	0.1406
27	0.01394	0.001698	0.02736	0.003787	0.01731	0.0001509	0.718	0.1366
28	0.01376	0.001672	0.02691	0.003718	0.01720	0.0001496	0.699	0.1327
29	0.01358	0.001647	0.02649	0.003651	0.01709	0.0001484	0.682	0.1292
30	0.01342	0.001624	0.02608	0.003588	0.01699	0.0001474	0.665	0.1257
35	0.01256	0.001501	0.02440	0.003315	0.01666	0.0001425	0.592	0.1105
40	0.01184	0.001391	0.02306	0.003082	0.01644	0.0001384	0.530	0.0973
45	0.01130	0.001300	0.02187	0.002858	0.01624	0.0001341	0.479	0.0860
50	0.01088	0.001216	0.02090	0.002657	0.01608	0.0001287	0.436	0.0761
60	0.01023	0.001052	0.01946	0.002274	0.01600	0.0001178	0.359	0.0576
70	0.00977	0.000851	0.01833	0.001856	0.0160	0.000102	—	—
80	0.00958	0.000660	0.01761	0.001381	0.0160	0.000079	—	—
90	0.0095	0.00038	0.0172	0.00079	0.0160	0.000046	—	—
100	0.0095	0.00000	0.0170	0.00000	0.0160	0.000000	—	—

* Atmospheric Nitrogen 98.815% Vol. N_2 + 1.185% Vol. A

GASES IN WATER

l is the volume of gas in c.c. dissolved by one volume of water when the total pressure (i.e., the sum of the partial pressure of the gas plus the aqueous tension at the given temperature) is 760 mm.

	Carbon Monoxide		Hydrogen Sulfide		Sulfur Dioxide		Nitric Oxide		Air**	
	α	q	α	q	l	q	α	q	cc/1000cc	$\%O_2$ in dissolved air
0	0.03537	0.004397	4.670	0.7066	79.789	22.83	0.07381	0.009833	29.18	34.91
1	0.03455	0.004293	4.522	0.6839	77.210	22.09	0.07184	0.009564	28.42	34.87
2	0.03375	0.004191	4.379	0.6619	74.691	21.37	0.06993	0.009305	27.69	34.82
3	0.03297	0.004092	4.241	0.6407	72.230	20.66	0.06809	0.009057	26.99	34.78
4	0.03222	0.003996	4.107	0.6201	69.828	19.98	0.06632	0.008816	26.32	34.74
5	0.03149	0.003903	3.977	0.6001	67.485	19.31	0.06461	0.008584	25.68	34.69
6	0.03078	0.003813	3.852	0.5809	65.200	18.65	0.06298	0.008361	25.06	34.65
7	0.03009	0.003725	3.732	0.5624	62.973	18.02	0.06140	0.008147	24.47	34.60
8	0.02942	0.003640	3.616	0.5446	60.805	17.40	0.05990	0.007943	23.90	34.56
9	0.02878	0.003559	3.505	0.5276	58.697	16.80	0.05846	0.007747	23.36	34.52
10	0.02816	0.003479	3.399	0.5112	56.647	16.21	0.05709	0.007560	22.84	34.47
11	0.02757	0.003405	3.300	0.4960	54.655	15.64	0.05587	0.007393	22.34	34.43
12	0.02701	0.003332	3.206	0.4814	52.723	15.09	0.05470	0.007233	21.87	34.38
13	0.02646	0.003261	3.115	0.4674	50.849	14.56	0.05357	0.007078	21.41	34.34
14	0.02593	0.003194	3.028	0.4540	49.033	14.04	0.05250	0.006930	20.97	34.30
15	0.02543	0.003130	2.945	0.4411	47.276	13.54	0.05147	0.006788	20.55	34.25
16	0.02494	0.003066	2.865	0.4287	45.578	13.05	0.05049	0.006652	20.14	34.21
17	0.02448	0.003007	2.789	0.4169	43.939	12.59	0.04956	0.006524	19.75	34.17
18	0.02402	0.002947	2.717	0.4056	42.360	12.14	0.04868	0.006400	19.38	34.12
19	0.02360	0.002891	2.647	0.3948	40.838	11.70	0.04785	0.006283	19.02	34.08
20	0.02319	0.002838	2.582	0.3846	39.374	11.28	0.04706	0.006173	18.68	34.03
21	0.02281	0.002789	2.517	0.3745	37.970	10.88	0.04625	0.006059	18.34	33.99
22	0.02244	0.002739	2.456	0.3648	36.617	10.50	0.04545	0.005947	18.01	33.95
23	0.02208	0.002691	2.396	0.3554	35.302	10.12	0.04469	0.005838	17.69	33.90
24	0.02174	0.002646	2.338	0.3463	34.026	9.76	0.04395	0.005733	17.38	33.86
25	0.02142	0.002603	2.282	0.3375	32.786	9.41	0.04323	0.005630	17.08	33.82
26	0.02110	0.002560	2.229	0.3290	31.584	9.06	0.04254	0.005530	16.79	33.77
27	0.02080	0.002519	2.177	0.3208	30.422	8.73	0.04188	0.005435	16.50	33.73
28	0.02051	0.002479	2.128	0.3130	29.314	8.42	0.04124	0.005342	16.21	33.68
29	0.02024	0.002442	2.081	0.3055	28.210	8.10	0.04063	0.005252	15.92	33.64
30	0.01998	0.002405	2.037	0.2983	27.161	7.80	0.04004	0.005165	15.64	33.60
35	0.01877	0.002231	1.831	0.2648	22.489	6.47	0.03734	0.004757		
40	0.01775	0.002075	1.660	0.2361	18.766	5.41	0.03507	0.004394		
45	0.01690	0.001933	1.516	0.2110	—	—	0.03311	0.004059		
50	0.01615	0.001797	1.392	0.1883	—	—	0.03152	0.003758		
60	0.01488	0.001522	1.190	0.1480	—	—	0.02954	0.003237		
70	0.01440	0.001276	1.022	0.1101	—	—	0.02810	0.002668		
80	0.01430	0.000980	0.917	0.0765	—	—	0.02700	0.001984		
90	0.0142	0.00057	0.84	0.041	—	—	0.0265	0.00113		
100	0.0141	0.00000	0.81	0.000	—	—	0.0263	0.00000		

** Cubic centimeters of air (free from CO_2 and NH_3) dissd. in 1000 c.c. H_2O with barometer at 760 mm. (total pressure).

INDICATORS

R. T. Thomson's table, showing the hydrogen atoms replaced by NaOH or KOH when a compound neutral to the indicator is formed. The blank spaces indicate that the end-reaction is obscure.

(From Cohn's Indicators and Test-papers, John Wiley and Sons, publishers, by permission.)

Acid	Formula	Methyl-orange Cold	Phenolphthalein		Litmus	
			Cold	Boiling	Cold	Boiling
Sulphuric	H_2SO_4	2	2	2	2	2
Hydrochloric	HCl	1	1	1	1	1
Nitric	HNO_3	1	1	1	1	1
Thiosulphuric	$H_2S_2O_3$	2	2	2	2	2
Carbonic	H_2CO_3	0	1 dilute	0	..	0
Sulphurous	H_2SO_3	1	2	..	..	..
Hydrosulphuric	H_2S	0	1 dilute	0	..	0
Phosphoric	H_3PO_4	1	2	..	..	..
Arsenic	H_3AsO_4	1	2	..	..	..
Arsenous	H_3AsO_3	4	..	..	0	0
Nitrous	HNO_2	indicator destroyed	1	..	1	..
Silicic	H_4SiO_4	0	..	..	0	0
Boric	H_3BO_3	0	..	..	..	..
Chromic	H_2CrO_4	1	2	2	..	..
Oxalic	$H_2C_2O_4$	..	2	2	2	2
Acetic	$HC_2H_3O_2$	..	1	.. 1	nearly	..
Butyric	$HC_4H_7O_2$	..	1	.. 1	nearly	..
Succinic	$H_2C_4H_4O_4$	..	2	.. 2	nearly	..
Lactic	$HC_3H_5O_3$	..	1	..	1	..
Tartaric	$H_2C_4H_4O_6$	..	2	..	2	..
Citric	$H_3C_6H_5O_7$	..	3	..	..	..

TABLE OF INDICATORS

Due to hydrolysis of the salt formed, the composition of a weak acid solution titrated against a strong base is basic (when equivalent amounts of acid and base are present) and of a weak base against a strong acid is acid. A truly neutral titrated solution has the same concentration of hydrogen ions $[H^+]$ and hydroxyl ions $[OH^-]$ as water. Water has a concentration of $[H^+]$ ion of 10^{-7} and of $[OH^-]$ ion of 10^{-7} at 25°C. As an index of the acid intensity the expression pH is employed and is equal to the logarithm of the reciprocal of the hydrogen ion concentration; i. e., $pH = \log \frac{1}{[H^+]}$ per liter. From this it follows that the pH of a neutral solution is the same as that of water; viz., 7; an acid solution has a pH less than 7 and a basic solution has a pH greater than 7. Those indicators in the table below with a * are the Sörensen selected indicators; those with a # are the Clark and Lubs selected indicators; those with the ## are Cohen's supplement to the Clark and Lubs selection; those with the *E* are the Eastman indicators.

TABLE OF INDICATORS (Continued)

Indicator	Synonym	pH Range	Observer
Mauveine		0.1–2.9 *	
α-Naphtholbenzein		0–1 } E 8–9 }	
Methyl Red (para)		0–2 E	
Methyl Violet		0–2 E 0.1–3.1 *	
Iodeosin	Tetraiodofluorescein	0.3–0 } E 4–5 }	
Benzoyl Auramine		0.1–1 E	
Quinaldine Red		1.2 E	
Diphenylamino-azo-benzene		1.2–2.1 *	
Tropeolin 00	Orange IV; diphenylamino azo-p-benzene sulfonic acid	1.4–2.6 * 1–3 E	
Metanil Yellow	Diphenylamino-azo-m-benzene sulfonic acid	1.2–2.3 *E	
Meta Cresol Purple		1.2–2.8 } ## 7.4–9.0 }	
Thymol Blue	Thymolsulfonphthalein	1.2–2.8 # 8.0–9.6	
Benzylaniline-azo-benzene sulfonic acid		1.9–3.3 *	
Ethyl Orange	Diethylaniline orange; sodium (or ammonium) diethylaniline-azo-benzene sulfonate	2–4 E	
Benzopurpurin 4B		2–4 E	
Benzylaniline-azo-benzene		2.3–3.3 *	
Red Cabbage Extract	Wild cabbage; sea cabbage; *Brassica oleracea*	2.4–4.5	Walbum
m-Chloro-diethyl aniline-azo-p-benzene sulfonic acid		2.6–4.0 *	
p-Dimethylamino-azo-benzene	Butter yellow; benzene-azo-dimethylaniline	2.9–4.0 * 3–4 E	
Congo Red	Sodium tetrazodiphenyl-naphthionate	3–5 E	Prideaux
2, 5-Dinitrohydro-quinone		3–9	Henderson and Forbes
Bromophenol Blue	Tetrabromophenolsulfon-phthalein	3.0–3.6 #E	
Methyl Orange[1]	Tropeolin D; orange III; Helianthine; Lunge's Indicator	2.9–4.0 E 3.1–4.4 *	
α-Naphthylamino-azo-p-benzene sulfonic acid		3.5–5.7 *	
α-Naphthylamino-azo-benzene		3.7–5.0 *	
Brom Cresol Green		3.8–5.4 ##	
o-Sulfo-o-methoxy-benzene-azo-dimethyl-α-napthylamine		4.0–4.6 E	
Iodeosin	*See iodeosin above*	4–5 } E 0.3–0 }	

[1] Methyl Orange may be used in the presence of carbon dioxide or hydrogen sulfide.

TABLE OF INDICATORS (Continued)

Indicator	Synonym	pH Range	Observer
Dinitrohydroquinone Acetate		4–5 } E 9–10 }	
Sodium Alizarinsulfonate		4–5 } E 5–6 }	
Dichlorofluorescein		4–6 E	Hottinger
Lacmosol		4.4–5.5	
Methyl Red		4.4–6.0 # 4.2–6.3 E	
Lacmoid		4.4–6.2	Sörensen
Tetrabromo-m-cresol-sulfonphthalein		4.5–5.5 E	
Azolitmin (Litmus)		4.5–8.3	Sörensen
Cochineal	Dried female insect, *Coccus cacti* Lin.; carminic acid	4.7–6.2	Sörensen
Chlor Phenol Red		4.8–6.4##	
Propyl Red		4.8–6.4 E	Lubs and Clark
Hematoxylin	From logwood, *Haematoxylon campechia* L.	5–6 E	
p-Nitrophenol		5.0–7.0 * 5–6 E	
Sodium Alizarinsulfonate		4–5 5–6 E	
Brom Phenol Red		5.2–6.8 ##	
Bromocresol Purple	Dibromo-o-cresolsulfonphthalein	5.2–6.8 #E	
Alizarin	Roots of madder; *Rubia tinctorum*, Lin. Dihydroxyanthraquinone; Schaal's Indicator.	5.5–6.8 } 10.1–12.1 }	Sörensen
Dinitrobenzoyleneurea		7–8 E 6–8	Bogart and Scatchard
Bromothymol Blue	Dibromothymolsulfomph halein	6.0–7.6 #E	
Anisolesulfonphthalein		6–8 E	
Curcumin	Turmeric Yellow; curcummin; roots of *Curcuma longa* L.	6.8 E	
Brilliant Yellow		6–8 E	
Neutral Red	Toluylene Red	6.8–8.0 *E	
Phenol Red	Phenolsulfonphthalein	6.8–8.4 #E	
Rosolic acid	Aurin; aurin red; corallin; p-rosolic acid	6.9–8.0 *E	
Cyanin	Quinoline Blue; diamylcyanine iodide	7–8	Prideaux
β-Naphtholphthalein		7.2–8.6 7–9 E	Sörensen and Palitzsch
Cresol Red	o-Cresolsulfonphthalein	7.2–8.8 #E	
Meta Cresol Purple		7.4–9.0 } 1.2–2.8 } ##	
Tropeolin 000	Orange I; Orange B; sodium-naphthol-azo-benzene sulfonate; von Muller's indicator	7.6–8.9 *	

TABLE OF INDICATORS (Continued)

Indicator	Synonym	pH Range	Observer
Thymol Blue	*See thymol blue above*	8.0–9.6 | #E 1.2–2.8 |	
α-Naphtholbenzein		8.9 E	
Cresolphthalein	o-Cresolphthalein	8.2 9.8 # 8–10 E	
Phenolphthalein[2]	Dihydroxyphthalophenone; Luck's indicator	8.3–10 *E	
Dinitrohydroquinone Acetate		9–10 E	
Alizarin Yellow R	Sodium p-nitrobenzene-azo-salicylate	9–10 E	
Tetranitrophenolsulfonphthalein		9–10 E	
Thymolphthalein		9.3–10.5 * 10–11 E	
Alizarin Yellow G	p-nitrobenzene-azo-salicylic acid	10.1–12.1 *	
Alizarin Blue S		11–13	Prideaux
Poirrier's Blue		11–13	Prideaux
Tropeolin 0	Resorcine-azo-benzene-sulfonic acid	11.1–12.7 *E	
Sodium Indigodisulfonate		12–14 E	
1,3,5-Trinitrobenzene		14–14.3 E	

[2] Phenolphthalein may be used in the presence of weak acids.

PREPARATION OF CLARK AND LUBS INDICATOR SOLUTIONS

To prepare a 0.04% indicator reagent, 0.1 gram of the dry indicator is mixed in a mortar with the number of cubic centimeters of 0.01 *N* sodium hydroxide as given in the table below and the mixture diluted to 250 cc with water. Such solutions give satisfactory results when five drops of indicator are added to 10 cc of the solution to be tested.

Indicator	0.01 *N* NaOH cc	Indicator	0.01 *N* NaOH cc
Brom cresol green	14.3	Chlor phenol red	23.6
Brom cresol purple	18.5	Cresol red	26.2
Brom phenol blue	14.9	Meta cresol purple	26.2
Brom phenol red	19.5	Phenol red	28.2
Brom thymol blue	16.0	Thymol blue	21.5

CONVERSION FACTORS—pH TO E. M. F.

When the half-cell:

KCl (saturated)|KCl (0.1*N*), HgCl (s)|Hg is used as a standard of reference and it is assumed, arbitrarily that in the cell: Pt, H_2 (1 atmosphere)|H^+ (unknown activity)|KCl (saturated)
A B
|KCl (0.1*N*), HgCl (s)|Hg
C D

the potential difference at **B** remains constant with variations of "H (unknown activity)" and that the sum of the potential differences at **B, C** and **D** is Σ as follows: (cf. Clark: *Determination of Hydrogen Ions*, 3d Ed., 1928).

t°C	18	20	25	30
Potential difference (Σ) volts	0.3380	0.3379	0.3376	0.3371

t°C	35	38	40
Potential difference (Σ) volts	0.3365	0.3361	0.3358

then,

$$\text{pH} = \frac{\text{E. M. F.} - \Sigma}{0.00019832 \times T}$$ where T is the absolute temperature.

Calomel Electrode

The voltage of the calomel electrode at 25°C. is for the half-cell:

$$Hg|HgCl, (N)\ KCl|| = +0.2822$$
$$Hg|HgCl, (0.1N\ KCl)|| = +0.3376$$
$$Hg|HgCl, (\text{saturated})\ KCl|| = +0.2458$$

From this the relation of the E. M. F. and pH (of a cell composed of a hydrogen electrode and one of the calomel electrodes) is given by:

$$pH = \frac{\text{E. M. F.} - \Sigma}{0.0591} \text{ (at 25°C.)}$$

Quinhydrone Electrode

The normal electrode potential (E_h) of the quinhydrone electrode referred to the normal hydrogen electrode at t°C. is given by the expression:

$$E_h = 0.7177 - 0.00074t$$

McILVAINE'S STANDARD BUFFER SOLUTIONS

Stock solution A: 0.1 molar citric acid ($C_6H_8O_7$) solution.
Stock solution B: 0.2 molar disodium phosphate (Na_2HPO_4) solution.

pH	Soln. A cc	Soln. B cc	pH	Soln. A cc	Soln. B cc
2.2	19.60	0.40	5.2	9.28	10.72
2.4	18.76	1.24	5.4	8.85	11.15
2.6	17.82	2.18	5.6	8.40	11.60
2.8	16.83	3.17	5.8	7.91	12.09
3.0	15.89	4.11	6.0	7.37	12.63
3.2	15.06	4.94	6.2	6.78	13.22
3.4	14.30	5.70	6.4	6.15	13.85
3.6	13.56	6.44	6.6	5.45	14.55
3.8	12.90	7.10	6.8	4.55	15.45
4.0	12.29	7.71	7.0	3.53	16.47
4.2	11.72	8.28	7.2	2.61	17.39
4.4	11.18	8.82	7.4	1.83	18.17
4.6	10.65	9.35	7.6	1.27	18.73
4.8	10.14	9.86	7.8	0.85	19.15
5.0	9.70	10.30	8.0	0.55	19.45

ELECTROLYTIC POTENTIALS

The electrolytic potentials of the following elements, arranged in the order of the electromotive series, are given at 25°C. with reference to the normal hydrogen electrode as zero. A *positive* value indicates that such an electrode is the *positive* pole of a cell formed by combination of such electrode with the standard electrode; similarly, a *negative* value indicates that the electrode is the *negative* pole of a cell when combined with the standard electrode. To convert the values given in the table to potentials referred to the normal calomel electrode the constant 0.2822 must be subtracted. The E. M. F. of a cell formed by combination of two normal electrodes is equal to the algebraic difference of their electrolytic potentials; thus, at 25°C., the E. M. F. of the cell $Zn|N.\ Zn^{++}||N.\ Cu^{++}|Cu$, is $-0.7581 - (+0.3448) = 1.1029$ volts.

Electrode	Potential	Authority
Li, Li^{+}	−3.0222	Lewis, Kraus
Rb, Rb^{+}	−2.9242	.....
K, K^{+}	−2.9256	Lewis, Keyes
Na, Na^{+}	−2.7153	Lewis, Kraus
Mg, Mg^{++} (18°)	−1.866	Beck
Zn, Zn^{++}	−0.7851	.....
Fe, Fe^{++}	−0.441	.....
Cd, Cd^{++}	−0.3976	.....
Tl, Tl^{+}	−0.3364	Richards, Smyth
Co, Co^{++}	−0.29	.....
Ni, Ni^{++}	−0.22	.....
Sn, Sn^{++}	−0.136	.....
Pb, Pb^{++}	−0.1295	Getman
H_2, H^{+}	±0.0000	.....
Bi, Bi^{+++} (18.5°)	+0.226	Jellinek, Kuhn
Cu, Cu^{++}	+0.3448	.....
Te, Te^{++++}	+0.558	Reichinst
Hg, Hg^{++}	+0.7986	.....
Ag, Ag^{+}	+0.799	Noyes,
Te, Te^{--} (18°)	−0.827	Reichinstein
S, S^{--}	−0.51	.....
O_2, OH^{-}	+0.3956	Lewis, Kraus
I_2, I^{-}	+0.5382	McKeown
Br_2, Br^{-}	+1.0659	.....
Cl_2, Cl^{-}	+1.3594	.....

NORMAL OXIDATION POTENTIALS

Electrode	Normal oxidation potential; volts $H^+ \rightarrow H = 0$	Authority
$Pt \left\vert \begin{matrix} V^{+++} \\ V^{++} \end{matrix} \right.$ N H_2SO_4, 18°C	−0.204	Rutter
$Pt \left\vert \begin{matrix} Sn^{++++} \\ Sn^{++} \end{matrix} \right.$ 0.6N NaOH, 18°C	−0.854	Foerster, Dolch
$Pt \left\vert \begin{matrix} Ti^{++++} \\ Ti^{+++} \end{matrix} \right.$ 4N H_2SO_4, 18°C	+0.056	Foerster, Diethelm
$Pt \left\vert \begin{matrix} Cr^{+++} \\ Cr^{++} \end{matrix} \right.$ 0.1N HCl, 25°C	+0.400	Forbes, Richter
$Pt \left\vert \begin{matrix} Fe(CN)_6^{---} \\ Fe(CN)_6^{----} \end{matrix} \right.$ 25°C	+0.406	Schaum, Linde
$Pt \left\vert \begin{matrix} Fe^{+++} \\ Fe^{++} \end{matrix} \right.$ slightly acid, 25°C	+0.743	Maitland
$Pt \left\vert \begin{matrix} Tl^{+++} \\ Tl^{+} \end{matrix} \right.$ 0.1N H_2SO_4, 18°C	+1.211	Grube, Hermann
$Pt \left\vert \begin{matrix} Ce^{++++} \\ Ce^{+++} \end{matrix} \right.$ sulfates in slightly acid soln., 17°C.	+1.431	Baur, Glaesson
$Pt \left\vert \begin{matrix} Ce^{++++} \\ Ce^{+++} \end{matrix} \right.$ nitrates in slightly acid soln., 17°C.	+1.567	Baur, Glaesson
$Pt \left\vert \begin{matrix} Mn^{+++} \\ Mn^{++} \end{matrix} \right.$ 15N H_2SO_4, 12°C	+1.511	Grube, Huberich
$Pt \left\vert \begin{matrix} Mn^{++++} \\ Mn^{++} \end{matrix} \right.$ 15N H_2SO_4, 12°C	+1.577	Grube, Huberich
$Pt \left\vert \begin{matrix} Co^{+++} \\ Co^{++} \end{matrix} \right.$	+1.76	Oberer

DEGREE OF IONIZATION

In Normal Solution at 18° Unless Indicated

Acids

Nitric acid	0.82	† Permanganic acid	0.933
Hydrochloric acid	0.784	† Hydriodic acid	0.901
Sulfuric acid	0.510	† Hydrobromic acid	0.899
Hydrofluoric acid	0.070	† Perchloric acid	0.880
* Oxalic acid	0.500	† Chloric acid	0.878
* Tartaric acid	0.082	† Hydrochloric acid	0.876
Acetic acid	0.004	† Phosphoric acid	0.170
* Carbonic acid	0.0017		
* Hydrogen sulfide	0.0007		
* Boric acid	0.0001		
* Hydrocyanic acid	0.0001		

* In 0.1 M. solution; primary ionization.
† In N/2 solution, at 25°.

Bases

Potassium hydroxide	0.77	‡ Strontium hydroxide	0.93
Sodium hydroxide	0.73	‡ Barium hydroxide	0.92
Barium hydroxide	0.69	‡ Calcium hydroxide	0.90
Lithium hydroxide	0.63		
Ammonium hydroxide	0.004		
Tetramethyl ammonium hydroxide	0.96		

‡ In N/64 solution, at 25°.

Salts

Approximate degree of ionization for active salts in N/10 solution:

Type R^+R^- (e.g. KCl)	0.86
Type $R^{++}(R^-)_2$ (e.g. $BaCl_2$)	0.72
Type $(R^+)_2R^{--}$ (e.g. K_2SO_4)	0.72
Type $R^{++}R^{--}$ (e.g. $BaSO_4$)	0.45

SOLUBILITY PRODUCT

The solubility product (or ion product constant) is the product of the concentrations of the ions in the saturated solution of a difficultly soluble salt. The concentrations are expressed as moles per liter of solution. The number of cations (or anions) resulting from the dissociation of one molecule of the salt, appears in the formula for calculations of the solubility product as the exponent of the concentration of the cation (or anion).

If two solutions, each containing one of the ions of a difficultly soluble salt, are mixed, no precipitation takes place unless the product of the ion concentrations in the mixture is greater than the solubility product.

In a solution containing two salts which yield a common ion the ratio of solubilities of the two salts is the ratio of the solubility products.

Substance	Solubility product at temperature noted	Substance	Solubility product at temperature noted
Aluminum hydroxide	4×10^{-13} (15°)	Calcium oxalate, $CaC_2O_4.H_2O$	1.78×10^{-9} (18°)
Aluminum hydroxide	1.1×10^{-15} (18°)	Calcium oxalate, $CaC_2O_4.H_2O$	2.57×10^{-9} (25°)
Aluminum hydroxide	3.7×10^{-15} (25°)	Calcium sulfate	6.1×10^{-5} (10°)
Barium carbonate	7×10^{-9} (16°)	Calcium tartrate, $CaC_4H_4O_6.2H_2O$	0.77×10^{-6} (18°)
Barium carbonate	8.1×10^{-9} (25°)	Cobalt sulfide	3×10^{-26} (18°)
Barium chromate	1.6×10^{-10} (18°)	Cupric iodate	1.4×10^{-7} (25°)
Barium chromate	2.4×10^{-10} (28°)	Cupric oxalate	2.87×10^{-8} (25°)
Barium fluoride	1.6×10^{-6} (9.5°)	Cupric sulfide	8.5×10^{-45} (18°)
Barium fluoride	1.7×10^{-6} (18°)	Cuprous bromide	4.15×10^{-8} (18–20°)
Barium fluoride	1.73×10^{-6} (25.8°)	Cuprous chloride	1.02×10^{-6} (18–20°)
Barium iodate, $Ba(IO_3)_2.2H_2O$	8.4×10^{-11} (10°)	Cuprous iodide	5.06×10^{-12} (18–20°)
Barium iodate, $Ba(IO_3)_2.2H_2O$	6.5×10^{-10} (25°)	Cuprous sulfide	2×10^{-47} (16–18°)
Barium oxalate, $BaC_2O_4.3\frac{1}{2}H_2O$	1.62×10^{-7} (18°)	Cuprous thiocyanate	1.6×10^{-11} (18°)
Barium oxalate, $BaC_2O_4.2H_2O$	1.2×10^{-7} (18°)	Ferric hydroxide	1.1×10^{-36} (18°)
Barium oxalate, $BaC_2O_4.\frac{1}{2}H_2O$	2.18×10^{-7} (18°)	Ferrous hydroxide	1.64×10^{-14} (18°)
Barium sulfate	0.87×10^{-10} (18°)	Ferrous oxalate	2.1×10^{-7} (25°)
Barium sulfate	1.08×10^{-10} (25°)	Ferrous sulfide	3.7×10^{-19} (18°)
Barium sulfate	1.98×10^{-10} (50°)	Lead carbonate	3.3×10^{-14} (18°)
Cadmium oxalate $CdC_2O_4.3H_2O$	1.53×10^{-8} (18°)	Lead chromate	1.77×10^{-14} (18°)
Cadmium sulfide	3.6×10^{-29} (18°)	Lead fluoride	2.7×10^{-8} (9°)
Calcium carbonate (calcite)	0.99×10^{-8} (15°)	Lead fluoride	3.2×10^{-8} (18°)
Calcium carbonate (calcite)	0.87×10^{-8} (25°)	Lead fluoride	3.7×10^{-8} (26.6°)
Calcium fluoride	3.4×10^{-11} (18°)	Lead iodate	5.3×10^{-14} (9.2°)
Calcium fluoride	3.95×10^{-11} (26°)	Lead iodate	1.2×10^{-13} (18°)
Calcium iodate, $Ca(IO_3)_2.6H_2O$	22.2×10^{-8} (10°)	Lead iodate	2.6×10^{-13} (25.8°)
Calcium iodate, $Ca(IO_3)_2.6H_2O$	64.4×10^{-8} (18°)	Lead iodide	7.47×10^{-9} (15°)
		Lead iodide	1.39×10^{-8} (25°)
		Lead oxalate	2.74×10^{-11} (18°)
		Lead sulfate	1.06×10^{-8} (18°)
		Lead sulfide	3.4×10^{-28} (18°)
		Lithium carbonate	1.7×10^{-3} (25°)
		Magnesium ammonium phosphate	2.5×10^{-13} (25°)

SOLUBILITY PRODUCT (Continued)

Substance	Solubility product at temperature noted
Magnesium carbonate	2.6×10^{-5} (12°)
Magnesium fluoride	7.1×10^{-9} (18°)
Magnesium fluoride	6.4×10^{-9} (27°)
Magnesium hydroxide	1.2×10^{-14} (18°)
Magnesium oxalate	8.57×10^{-5} (18°)
Manganese hydroxide	4×10^{-14} (18°)
Manganese sulfide	1.4×10^{-15} (18°)
Mercuric sulfide	4×10^{-53} to 2×20^{-49} (18°)
Mercurous bromide	1.3×10^{-21} (25°)
Mercurous chloride	2×10^{-18} (25°)
Mercurous iodide	1.2×10^{-28} (25°)
Nickel sulfide	1.4×10^{-24} (18°)
Potassium acid tartrate $[K^+][HC_4H_4O_6^-]$	3.8×10^{-4} (18°)
Silver bromate...	3.97×10^{-5} (20°)
Silver bromate...	5.77×10^{-5} (25°)
Silver bromide...	4.1×10^{-13} (18°)
Silver bromide...	7.7×10^{-13} (25°)
Silver carbonate..	6.15×10^{-12} (25°)
Silver chloride...	0.21×10^{-10} (4.7°)
Silver chloride...	0.37×10^{-10} (9.7°)
Silver chloride...	1.56×10^{-10}(25°)
Silver chloride...	13.2×10^{-10} (50°)
Silver chloride...	21.5×10^{-10} (100°)
Silver chromate..	1.2×10^{-12} (14.8°)
Silver chromate..	9×10^{-12} (25°)
Silver cyanide $[Ag^+][Ag(CN)^-_2]$	2.2×10^{-12} (20°)
Silver dichromate	2×10^{-7} (25°)
Silver hydroxide..	1.52×10^{-8} (20°)
Silver iodate.....	0.92×10^{-8} (9.4°)
Silver iodide.....	0.32×10^{-16} (13°)
Silver iodide.....	1.5×10^{-16} (25°)
Silver sulfide.....	1.6×10^{-49} (18°)
Silver thiocyanate	0.49×10^{-12} (18°)
Silver thiocyanate	1.16×10^{-12} (25°)
Strontium carbonate	1.6×10^{-9} (25°)
Strontium fluoride	2.8×10^{-9} (18°)
Strontium oxalate	5.61×10^{-8} (18°)
Strontium sulfate	2.77×10^{-7} (2.9°)
Strontium sulfate	2.81×10^{-7} (17.4°)
Zinc hydroxide...	1.8×10^{-14} (18–20°)
Zinc oxalate, $ZnC_2O_4.2H_2O$	1.35×10^{-9} (18°)
Zinc sulfide.....	1.2×10^{-23} (18°)

DISSOCIATION CONSTANTS OF ACIDS

Acid	Formula	Constant for the first hydrogen	Temp. °C.	Constant for the second hydrogen	Temp. °C.
Acetic	$C_2H_4O_2$	1.86×10^{-5}	25		
α-Alanine	$C_3H_7O_2N$	9×10^{-10}	25		
Arsenic	H_3AsO_4	5×10^{-3}	25	4×10^{-5}	25
				6×10^{-10} (3H)	25
Arsenious	H_3AsO_3	6×10^{-10}	25		
Barbituric	$C_4H_4O_3N$	1.05×10^{-4}	25		
Benzoic	$C_7H_6O_2$	6.6×10^{-5}	25		
Boric	H_3BO_3	6.4×10^{-10}	25		
Bromacetic	$C_2H_3O_2Br$	1.38×10^{-3}	25		
α-Brompropionic	$C_3H_5O_2Br$	1.08×10^{-3}	25		
β-Brompropionic	$C_3H_5O_2Br$	9.8×10^{-5}	25		
Butyric	$C_4H_8O_2$	1.48×10^{-5}	25		
Carbonic	H_2CO_3	3×10^{-7}	18	6×10^{-11}	25
Chloracetic	$C_2H_3O_2Cl$	1.55×10^{-3}	25		
α-Chlorpropionic	$C_3H_5O_2Cl$	1.47×10^{-3}	25		
β-Chlorpropionic	$C_3H_5O_2Cl$	8.59×10^{-5}	25		
Citric	$C_6H_8O_7$	8×10^{-4}	25		
Dichloracetic	$C_2H_2O_2Cl_2$	5×10^{-2}	25		
Formic	CH_2O_2	2.14×10^{-4}	25		
Fumaric	$C_4H_4O_4$	1×10^{-3}	25	3×10^{-5}	25
Hippuric	$C_9H_9O_3N$	2.3×10^{-4}	25		
Hydrocyanic	CHN	7.2×10^{-10}	25		
Hydroquinone	$C_6H_6O_2$	1.1×10^{-10}	18		
Hydrosulfuric	H_2S	9.1×10^{-8}	18	1.2×10^{-15}	
Hydrazoic	HN_3	1.9×10^{-5}	25		
Hypochlorous	$HOCl$	3.7×10^{-8}	17		
Iodic	HIO_3	1.9×10^{-1}	25		
Isobutyric	$C_4H_8O_2$	1.5×10^{-5}	25		
Isovaleric	$C_5H_{10}O_2$	1.7×10^{-5}	25		
Lactic	$C_3H_6O_3$	1.38×10^{-4}	25		
Maleic	$C_4H_4O_4$	1.5×10^{-2}	25	2.6×10^{-7}	25
Malic	$C_4H_6O_5$	4×10^{-4}	25	9×10^{-6}	25
Malonic	$C_3H_4O_4$	1.61×10^{-3}	25	2.1×10^{-6}	25
Mandelic	$C_8H_8O_3$	4.29×10^{-4}	25		
α-Naphthoic	$C_{11}H_8O_2$	2×10^{-4}	25		
β-Naphthoic	$C_{11}H_8O_2$	6.8×10^{-5}	25		
Nicotinic	$C_6H_5O_2N$	1.4×10^{-5}	25		
Nitrous	HNO_2	4×10^{-4}	18		
Oxalic	$C_2H_4O_4$	3.8×10^{-2}	25	4.9×10^{-5}	25
Periodic	HIO_4	2.3×10^{-2}	25		
Phenol	C_6H_6O	1.3×10^{-10}	25		
Phosphoric	H_3PO_4	1.1×10^{-2}	18	2×10^{-7}	18
				3.6×10^{-13}(3H)	18
Phosphorous	H_3PO_3	5×10^{-2}	25	2×10^{-6}	25
Phthalic	$C_8H_6O_4$	1.26×10^{-3}	25	3.1×10^{-6}	25
Picolinic	$C_6H_5O_2N$	3×10^{-2}	25		
Picric	$C_6H_3O_7N_3$	1.6×10^{-1}	18		
Propionic	$C_3H_6O_2$	1.4×10^{-5}	25		
Pyromucic	$C_5H_4O_3$	7.1×10^{-4}	25		
Pyrophosphoric	$H_4P_2O_7$	1.4×10^{-1}	18	1.1×10^{-2}	18
				2.9×10^{-7}(3H)	18
				3.6×10^{-9}(4H)	18
Pyrotartaric	$C_5H_8O_4$	8.7×10^{-5}	25		
Salicylic	$C_7H_6O_3$	1.06×10^{-3}	25	1×10^{-13}	20
Selenious	H_2SeO_3	3×10^{-3}	25	5×10^{-8}	25
Succinic	$C_4H_6O_4$	6.6×10^{-5}	25	2.8×10^{-6}	25
Sulfanilic	$C_6H_7O_3NS$	6.2×10^{-4}			
Sulfuric	H_2SO_4	.....	.....	2×10^{-2}	18

DISSOCIATION CONSTANTS OF ACIDS (Continued)

Acid	Formula	Constant for the first hydrogen	Temp. °C.	Constant for the second hydrogen	Temp. °C.
Sulfurous	H_2SO_3	1.7×10^{-2}	25	5×10^{-6}	25
Tartaric	$C_4H_6O_6$	1.1×10^{-3}	25	6.9×10^{-6}	25
Telluric	H_2TeO_4	6×10^{-7}	25	4×10^{-11}	25
Tellurous	H_2TeO_3	3×10^{-3}	25	2×10^{-8}	25
Trichloracetic	$C_2HO_2Cl_3$	2×10^{-1}	18		
Uric	$C_5H_4O_3N_4$	1.5×10^{-4}	25		
Valeric	$C_5H_{10}O_2$	1.6×10^{-5}	25		

DISSOCIATION CONSTANTS OF BASES

Name	Formula	Constant for first OH	Temp. °C.	Constant for second OH	Temp. °C.
Acetamide	C_2H_5ON	3.1×10^{-15}	25		
Acetanilide	C_8H_9ON	4.1×10^{-14}	40		
α-Alanine	$C_3H_7O_2N$	5.1×10^{-12}	25		
p-Aminobenzoic	$C_7H_7O_2N$	1.4×10^{-12}	25		
Ammonium Hydroxide	NH_4OH	1.8×10^{-5}	25		
Aniline	C_6H_7N	4.6×10^{-10}	25		
Arsenious Oxide	As_2O_3	1×10^{-14}	25		
Beryllium Hydroxide	$Be(OH)_2$			5×10^{-11}	25
Brucine	$C_{23}H_{26}O_4N_2$	7.2×10^{-6}	25	2.5×10^{-11}	25
Butylamine (sec.)	$C_4H_{11}N$	4.4×10^{-4}	25		
Caffeine	$C_8H_{10}O_2N_4$	4.1×10^{-14}	40		
Cinchonine	$C_{19}H_{22}ON_2$	1.6×10^{-7}	15	3.3×10^{-10}	15
Cocaine	$C_{17}H_{21}O_4N$	4×10^{-7}	25		
Diethylbenzylamine	$C_{11}H_{17}N$	3.6×10^{-5}	25		
Diethylamine	$C_4H_{11}N$	1.26×10^{-3}	25		
Diisoamylamine	$C_{10}H_{23}N$	9.6×10^{-4}	25		
Diisobutylamine	$C_8H_{19}N$	4.8×10^{-4}	25		
Dimethylamine	C_2H_7N	7.4×10^{-4}	25		
Dimethylbenzylamine	$C_9H_{13}N$	1.05×10^{-5}	25		
Dipropylamine	$C_6H_{15}N$	1.02×10^{-3}	25		
Ethylamine	C_2H_7N	5.6×10^{-4}	25		
Ethylenediamine	$C_2H_8N_2$	8.5×10^{-5}	25		
Hydrazine	$N_2H_4.H_2O$	3×10^{-6}	25		
Isoamylamine	$C_5H_{13}N$	5×10^{-4}	25		
Isobutylamine	$C_4H_{11}N$	3.1×10^{-4}	25		
Isopropylamine	C_3H_9N	5.3×10^{-4}	25		
Lead Hydroxide	$Pb(OH)_2$			3×10^{-8}	25
Methylamine	CH_5N	5×10^{-4}	25		
Methyldiethylamine	$C_5H_{13}N$	2.7×10^{-4}	25		
α-Naphthylamine	$C_{10}H_9N$	9.9×10^{-11}	25		
β-Naphthylamine	$C_{10}H_9N$	2×10^{-10}	25		
o-Phenylenediamine	$C_6H_8N_2$	3.3×10^{-10}	25		
Phenylhydrazine	$C_6H_8N_2$	1.6×10^{-9}	40		
Piperidine	$C_5H_{11}N$	1.6×10^{-3}	25		
Propylamine (norm.)	C_3H_9N	4.7×10^{-4}	25		
Pyridine	C_5H_5N	2.3×10^{-9}	25		
Quinine	$C_{20}H_{24}O_2N_2$	2.2×10^{-7}	15	3.3×10^{-10}	15
Quinoline	C_9H_7N	1×10^{-9}	25		
Semicarbazide	CH_5ON_3	2.7×10^{-11}	40		
Silver Hydroxide	$AgOH$	1.1×10^{-4}	25		
Strychnine	$C_{21}H_{22}O_4N_2$	1×10^{-7}	15	6×10^{-11}	15
Tetramethylenediamine	$C_4H_{12}N_2$	5.1×10^{-4}	25		
Thiourea	CH_4N_2S	1.1×10^{-15}	25		
m-Toluidine	C_7H_9N	5.5×10^{-10}	25		
o-Toluidine	C_7H_9N	3.3×10^{-10}	25		
p-Toluidine	C_7H_9N	2×10^{-9}	25		
Triethylamine	$C_6H_{15}N$	6.4×10^{-4}	25		
Triisobutylamine	$C_{12}H_{27}N$	2.6×10^{-4}	25		
Trimethylamine	C_3H_9N	7.4×10^{-5}	25		
Trimethylenediamine	$C_3H_{10}N_2$	3.5×10^{-4}	25		
Tripropylamine	$C_9H_{21}N$	5.5×10^{-4}	25		
Urea	CH_4ON_2	1.5×10^{-14}	25		
Zinc Hydroxide	$Zn(OH)_2$			1.5×10^{-9}	25

ELECTROMOTIVE FORCE SERIES OF METALS

Alkali...Cs.Rb.K.Na.Li...		
Alkaline-earth..Ba.Sr.Ca..		
Magnesium.....Mg		
Aluminum.....Al		1.276
Manganese.....Mn		1.075
Zinc.....Zn		0.770
Chromium.....Cr		
Cadmium.....Cd		0.420
Iron.....Fe		0.340
Cobalt.....Co		0.232
Nickel.....Ni		0.228
Tin.....Sn		0.192
Lead.....Pb		0.148
Hydrogen.....(H)		0.000
Copper.....Cu		0.336
Arsenic.....As		
Bismuth.....Bi		
Antimony.....Sb		
Mercury.....Hg		0.798
Silver.....Ag		0.771
Palladium.....Pd		
Platinum.....Pt		0.863
Gold.....Au		1.078

1. Any metal will replace any other metal, *below it* in the series, thus

$$Fe + CuSO_4 = FeSO_4 + Cu$$
$$Zn + FeSO_4 = ZnSO_4 + Fe$$
$$Fe + 2HCl = FeCl_2 + H_2$$
$$Zn + H_2SO_4 = ZnSO_4 + H_2$$
$$Cu + HCl = \text{No action.}$$ Cu insoluble.
$$Ag + HCl = \text{No action.}$$ Ag insoluble.
$$Cu + (\text{dilute})\ H_2SO_4 = \text{No action.}$$
$$Ag + CuSO_4 = \text{No action.}$$ Ag below Cu.

Note.—It is true that dilute and conc. HNO_3 and *hot conc.* H_2SO_4 wil dissolve most of the metals. When they thus dissolve metals below hydroge in the series, the action is an oxidizing one, and the acids are reduced t NO and SO_2 respectively. The metal is first oxidized to the oxide, th acid being thus at the same time reduced, and the oxide thus formed the reacts with the acid molecule present, and goes into solution as a salt

(*a*) $Cu + (\text{dilute})\ H_2SO_4 = \text{No action.}$
(*b*) $Cu + 2\ (\text{hot conc.})\ H_2SO_4 = CuSO_4 + SO_2 + 2H_2O.$

In (*b*), the Cu is first converted to CuO, thus

$$Cu + H_2SO_4 = CuO + H_2O + SO_2,$$

then the CuO reacts with another molecule of H_2SO_4, thus

$$CuO + H_2SO_4 = CuSO_4 + H_2O.$$

Added

$$3Cu + 2HNO_3 = 3CuO + 2NO + H_2O$$
$$3CuO + 6HNO_3 = 3Cu(NO_3)_2 + 3H_2O$$
$$3Cu + 8HNO_3 = 3Cu(NO_3)_2 + 2NO + 4H_2O.$$

2. **In Regard to Ease of Reduction of Oxides.**—The metallic oxides dow to and including Mn can not be completely reduced to the metal stat even in a current of hydrogen. The oxides of Cd and succeeding meta are easily reduced, and far down the list, the oxides of silver, platinur mercury, and gold are reduced (decomposed into metal and oxygen) eve by heat alone.

3. **In Regard to Ease of Rusting. (Oxidation in the Air.)**—The alkali a alkaline-earth metals rust very rapidly and with considerable evolutio of heat. All the metals down to copper rust with comparative eas The metals below copper do not rust. Assuming the electrolytic theo of the process of rusting to be true, these facts are just about what mig have been predicted.

4. **In Regard to the Occurrence of the Metals in the Free State in Natur** —Natural waters are frequently dilute solutions of carbonic, nitric, humi etc., acids. As such they contain displaceable hydrogen. Metals *abo* hydrogen in the E.M.F. series scarcely, if ever, occur in the free sta in nature, but are practically without exception found in the combine state, as sulphides, carbonates, etc. Metals *below* hydrogen are frequent found in the free state in nature. Thus gold is found in the form of nugge of metallic gold. However, metals below hydrogen are also found in t combined state, as cinnabar, HgS, etc.

5. **In Regard to Action of the Metals on Water.**—The alkali a alkaline-earths metal displace hydrogen from water, even in the col

nd with evolution of much heat. Mg and succeeding metals will dislace hydrogen from steam. Metals at the bottom of the list will not isplace hydrogen from steam.

6. **In Regard to the Solubility and Stability of Hydroxides.**—The alkali netal oxides have great avidity for water, forming hydroxides. The lkaline-earth metal oxides react with less readiness, forming hydroxides. IgO reacts slowly and incompletely with water, forming the hydroxide. ll the other metallic oxides and hydroxides are insoluble in water and ave no perceptible reaction therewith. When a solution of NaOH acts on olutions of salts of the metals, the alkali metal salts are not precipitated. he alkaline-earth metal salts are not precipitated unless in very conentrated solution. All the other metal solutions are acted upon, with recipitation of hydroxides, except in the case of copper which first gives opper hydroxide (blue), and which, on warming, changes to copper oxide black). Also in the case of arsenic, no precipitate falls, sodium arsenite eing formed. In the case of the last metals in the series, the *oxide* is recipitated, instead of the hydroxide, thus NaOH acting on salts of Sb, lg, Ag, Pd, Pt, and Au, causes a precipitation of the *oxides* of these metals. ismuth, as an exception, gives a normal hydroxide.

7. **In Regard to Carbonates.**—The alkali metals form normal stable, oluble carbonates, not easily decomposed on heating. The alkaline-earth netals form normal carbonates, which are insoluble in water, and which lecompose upon heating, leaving the oxide, carbon dioxide being evolved. Vhen sodium carbonate solution acts on solutions of all the other metals, s a rule, a basic carbonate is precipitated, being insoluble in water, and lecomposed by heat into oxide and carbon dioxide. If the solution is cold, \g, Hg, Cd, Fe, and Mn give normal carbonates. If the solution is warm, Sb, Hg, Ag, Pd, Pt, and Au give a precipitate of the *oxide*, instead of the arbonate, thus showing the instability of the carbonates of the lowest netals in the series.

8. **In Regard to Voltaic Cells.**—In choosing metals to acts as electrodes n voltaic cells, the farther apart the metals chosen, the greater the electronotive force of the voltaic cell. Thus the Al-Au couple gives a greater E.M.F. than the Zn-Cu couple.

For complete information, see Alex. Smith's Gen. Inorganic Chem., pages 361–363; 664–680. J. W. Mellor's Modern Inorg. Chem., pages 362–376.

REDUCTION VALUES FOR GLUCOSE IN BLOOD

Amounts of Glucose Corresponding to Titration Values when 0.1 c.c. Blood is Used in the Method of Hagedorn and Jensen. Biochem. Zeit. 135, 46; 137, 92 (1923).

Milligrams of Glucose in 0.1 c.c. of Blood

c.c. of 0.005N $Na_2S_2O_3$	Hundredths of 1 c.c. of 0.005 N Sodium Thiosulfate, $Na_2S_2O_3$									
	0	1	2	3	4	5	6	7	8	9
0.0	0.385	0.382	0.379	0.376	0.373	0.370	0.367	0.364	0.361	0.358
0.1	0.355	0.352	0.350	0.348	0.345	0.343	0.341	0.338	0.336	0.333
0.2	0.331	0.329	0.327	0.325	0.323	0.321	0.318	0.316	0.314	0.312
0.3	0.310	0.308	0.306	0.304	0.302	0.300	0.298	0.296	0.294	0.292
0.4	0.290	0.288	0.286	0.284	0.282	0.280	0.278	0.276	0.274	0.272
0.5	0.270	0.268	0.266	0.264	0.262	0.260	0.259	0.257	0.255	0.253
0.6	0.251	0.249	0.247	0.245	0.243	0.241	0.240	0.238	0.236	0.234
0.7	0.232	0.230	0.228	0.226	0.224	0.222	0.221	0.219	0.217	0.215
0.8	0.213	0.211	0.209	0.208	0.206	0.204	0.202	0.200	0.199	0.197
0.9	0.195	0.193	0.191	0.190	0.188	0.186	0.184	0.182	0.181	0.179
1.0	0.177	0.175	0.173	0.172	0.170	0.168	0.166	0.164	0.163	0.161
1.1	0.159	0.157	0.155	0.154	0.152	0.150	0.148	0.146	0.145	0.143
1.2	0.141	0.139	0.138	0.136	0.134	0.132	0.131	0.129	0.127	0.125
1.3	0.124	0.122	0.120	0.119	0.117	0.115	0.113	0.111	0.110	0.108
1.4	0.106	0.104	0.102	0.101	0.099	0.097	0.095	0.093	0.092	0.090
1.5	0.088	0.086	0.084	0.083	0.081	0.079	0.077	0.075	0.074	0.072
1.6	0.070	0.068	0.066	0.065	0.063	0.061	0.059	0.057	0.056	0.054
1.7	0.052	0.050	0.048	0.047	0.045	0.043	0.041	0.039	0.038	0.036
1.8	0.034	0.032	0.031	0.029	0.027	0.025	0.024	0.022	0.020	0.019
1.9	0.017	0.015	0.014	0.012	0.010	0.008	0.007	0.005	0.003	0.002

Procedure

Into a test tube (15 × 150 mm.) pipette 1 c.c. 0.1 normal NaOH and 5 c.c. 0.45% zinc sulfate solution; 0.1 c.c. of blood from a capillary pipette is added being washed out with the mixture in the test tube; heat for 3 minutes in a boiling water bath: filter through cotton into a test tube (30 × 90 mm.) and wash the filter with two 3 c.c. portions of water. Add 2 c.c. of alkaline ferricyanide solution (1.65 g potassium ferricyanide, 10.6 g anhydrous sodium carbonate in 1000 c.c. of water) and heat in a boiling water bath for 15 minutes; cool and add 3 c.c. of the iodide-sulfate solution (5 g potassium iodide, 10 g zinc sulfate, 50 g sodium chloride and sufficient water to make 200 c.c.) and 2 c.c. of 3 % acetic acid solution. Titrate with 0.005 normal sodium thiosulfate using starch indicator. The method is based upon the reduction of alkaline ferricyanide by glucose and the subsequent titration of the excess unreduced ferricyanide according to the following equation: $2H_3Fe(CN)_6 + 2HI = 2H_4Fe(CN)_6 + I_2$

Amounts of Glucose Corresponding to Titration Values when 5 c.c. of 1:10 Blood Filtrate and 5 c.c. of Copper Reagent (Modified*) are Heated in a Water Bath for 15 Minutes. M. Somogyi, Jour. Biol. Chem. 70, 599 (1926).

c.c. of 0.005N $Na_2S_2O_3$	Milligrams of Glucose in 100 c.c. of Blood: Tenths of 1 c.c. of 0.005 N Sodium Thiosulfate, $Na_2S_2O_3$									
	0	1	2	3	4	5	6	7	8	9
0			21	23	26	29	31	34	36	39
1	41	44	46	49	51	53	56	58	61	63
2	65	68	70	72	75	77	80	82	84	86
3	89	92	94	97	99	101	103	106	108	110
4	113	115	117	119	121	124	126	128	130	132
5	135	137	139	141	143	146	148	150	152	154
6	157	159	161	163	165	168	170	172	174	176
7	179	181	183	185	187	190	192	194	196	199
8	201	203	205	207	210	212	214	216	218	221
9	223	225	227	230	232	234	237	239	241	243
10	245	248	250	252	254	256	259	261	263	265
11	267	270	272	274	276	279	281	283	285	288
12	290	292	294	296	299	301	303	305	308	310
13	312	314	316	318	321	323	326	328	330	332
14	334	337	339	341	343	345	347	350	352	354
15	356	359	361	363	365	367	370	372	374	376
16	378	381	383	386	388	390	392	394	396	398
17	400	+	+	+	+	+	+	+	+	+

To 5 c.c. of the copper reagent in a test tube (250 × 25 mm) are added 5 c.c. of the sugar solution containing between 0.1 and 2.0 mg of glucose; mix; heat for 15 minutes in a boiling water bath; cool to 35°C; with mixing add 1 c.c. of 5N H_2SO_4 and 2 minutes later titrate with 0.005 normal $Na_2S_2O_3$. A blank titration using 5 c.c. of water in place of the blood is run at the same time.

Amounts of Glucose Corresponding to Titration Values when 2 c.c. of 1:15 Blood Filtrate and 2 c.c. of Copper Reagent (Modified*) are Heated in a Water Bath for 15 Minutes. M. Somogyi, Jour. Biol. Chem. 70, 599 (1926).

c.c. of 0.005N $Na_2S_2O_3$	Milligrams of Glucose in 100 c.c. of Blood: Tenths of 1 c.c. of 0.005 N Sodium Thiosulfate, $Na_2S_2O_3$									
	0	1	2	3	4	5	6	7	8	9
0	–	–	42	53	63	74	83	91	100	108
1	117	125	134	142	150	159	168	176	185	193
2	202	210	219	227	236	245	253	262	270	279
3	288	296	305	313	322	330	339	347	355	364
4	373	381	390	399	407	416	424	433	441	450
5	458	+	+	+	+	+	+	+	+	–

To 2 c.c. of 0.0667 normal H_2SO_4 in a test tube add 0.2 c.c. of blood, rinsing the pipette several times with the liquid in the test tube; add exactly 0.2 c.c. of 2.5% sodium tungstate solution; centrifugate; fasten a small tuft of absorbent cotton over the end of a 2 c.c. pipette and with this pipette remove 2 c.c. of the blood filtrate in the test tube and deliver it into a 16 × 150 mm. test tube; add exactly 2 c.c. of the sugar-copper reagent; mix; heat in a boiling water bath for 15 minutes; cool to 35°C.; add 1 c.c. 2 normal H_2SO_4 and titrate with 0.005 normal $Na_2S_2O_3$. A blank using 0.2 c.c. of water in place of the blood is run at the same time.

* Modified tartrate-carbonate copper reagent. — Copper sulfate (crystalline) 6.5 g; rochelle salt 12 g; sodium carbonate (anhydrous) 20 g; potassium iodide 10 g; potassium iodate 0.08 g; potassium oxalate 18 g; sodium bicarbonate 25 g; water sufficient to make one liter of solution.

CUPROUS OXIDE EQUIVALENT OF DEXTROSE, INVERT SUGAR, LACTOSE AND MALTOSE

(Munson and Walker, Jour. Amer. Chem. Soc. 28, 663 (1906.)

Add exactly 25 c.c. of Fehling Solution A and 25 c.c. of Fehling Solution B (see under *Special Solutions and Reagents*) to 50 c.c. of reducing sugar solution (if a smaller volume of sugar solution is used, add sufficient water to make the final solution 100 c.c.); heat the solution at such a rate that boiling begins in four minutes and continue boiling for exactly 2 minutes, keeping the beaker covered with a watch glass; filter immediately on a Gooch crucible using suction; wash thoroughly with water at 60°C., then with 10 c c. of alcohol and finally with 10 c.c. of ether; dry for 30 minutes in an oven at 100°C., cool in a desiccator and weigh as cuprous oxide.

(Expressed in Milligrams)

Cuprous Oxide Cu_2O	Dextrose $C_6H_{12}O_6$	Invert Sugar	Lactose $C_{12}H_{22}O_{11}$	Maltose $C_{12}H_{22}O_{11}$	Cuprous Oxide Cu_2O	Dextrose $C_6H_{12}O_6$	Invert Sugar	Lactose $C_{12}H_{22}O_{11}$	Maltose $C_{12}H_{22}O_{11}$
10	4.0	4.5	3.8	5.9	50	21.3	22.3	30.1	37.6
11	4.5	5.0	4.5	6.7	51	21.7	22.8	30.7	38.4
12	4.9	5.4	5.1	7.5	52	22.2	23.2	31.4	39.2
13	5.3	5.8	5.8	8.3	53	22.6	23.7	32.1	40.0
14	5.7	6.3	6.4	9.1	54	23.0	24.1	32.7	40.8
15	6.2	6.7	7.1	9.9	55	23.5	24.6	33.4	41.6
16	6.6	7.2	7.8	10.6	56	23.9	25.0	34.0	42.4
17	7.0	7.6	8.4	11.4	57	24.3	25.5	34.7	43.2
18	7.5	8.1	9.1	12.2	58	24.8	25.9	35.4	44.0
19	7.9	8.5	9.7	13.0	59	25.2	26.4	36.0	44.8
20	8.3	8.9	10.4	13.8	60	25.6	26.8	36.7	45.6
21	8.7	9.4	11.0	14.6	61	26.1	27.3	37.3	46.3
22	9.2	9.8	11.7	15.4	62	26.5	27.7	38.0	47.1
23	9.6	10.3	12.3	16.2	63	27.0	28.2	38.6	47.9
24	10.0	10.7	13.0	17.0	64	27.4	28.6	39.3	48.7
25	10.5	11.2	13.7	17.8	65	27.8	29.1	40.0	49.5
26	10.9	11.6	14.3	18.6	66	28.3	29.5	40.6	50.3
27	11.3	12.0	15.0	19.4	67	28.7	30.0	41.3	51.1
28	11.8	12.5	15.6	20.2	68	29.2	30.4	41.9	51.9
29	12.2	12.9	16.3	21.0	69	29.6	30.9	42.6	52.7
30	12.6	13.4	16.9	21.8	70	30.0	31.3	43.3	53.5
31	13.1	13.8	17.6	22.6	71	30.5	31.8	43.9	54.3
32	13.5	14.3	18.3	23.3	72	30.9	32.3	44.6	55.1
33	13.9	14.7	18.9	24.1	73	31.4	32.7	45.2	55.9
34	14.3	15.2	19.6	24.9	74	31.8	33.2	45.9	56.7
35	14.8	15.6	20.2	25.7	75	32.2	33.6	46.6	57.5
36	15.2	16.1	20.9	26.5	76	32.7	34.1	47.2	58.2
37	15.6	16.5	21.5	27.3	77	33.1	34.5	47.9	59.0
38	16.1	16.9	22.2	28.1	78	33.6	35.0	48.5	59.8
39	16.5	17.4	22.8	28.9	79	34.0	35.4	49.2	60.6
40	16.9	17.8	23.5	29.7	80	34.4	35.9	49.9	61.4
41	17.4	18.3	24.2	30.5	81	34.9	36.3	50.5	62.2
42	17.8	18.7	24.8	31.3	82	35.3	36.8	51.2	63.0
43	18.2	19.2	25.5	32.1	83	35.8	37.3	51.8	63.8
44	18.7	19.6	26.1	32.9	84	36.2	37.7	52.5	64.6
45	19.1	20.1	26.8	33.7	85	36.7	38.2	53.1	65.4
46	19.6	20.5	27.4	34.4	86	37.1	38.6	53.8	66.2
47	20.0	21.0	28.1	35.2	87	37.5	39.1	54.5	67.0
48	20.4	21.4	28.7	36.0	88	38.0	39.5	55.1	67.8
49	20.9	21.9	29.4	36.8	89	38.4	40.0	55.8	68.6

CUPROUS OXIDE EQUIVALENT OF DEXTROSE, INVERT SUGAR, LACTOSE AND MALTOSE (Continued)

Cuprous Oxide Cu_2O	Dextrose $C_6H_{12}O_6$	Invert Sugar	Lactose $C_{12}H_{22}O_{11}$	Maltose $C_{12}H_{22}O_{11}$	Cuprous Oxide Cu_2O	Dextrose $C_6H_{12}O_6$	Invert Sugar	Lactose $C_{12}H_{22}O_{11}$	Maltose $C_{12}H_{22}O_{11}$
90	38.9	40.4	56.4	69.3	140	61.3	63.6	89.5	109.0
91	39.3	40.9	57.1	70.1	141	61.8	64.0	90.2	109.8
92	39.8	41.4	57.8	70.9	142	62.2	64.5	90.8	110.5
93	40.2	41.8	58.4	71.7	143	62.7	65.0	91.5	111.3
94	40.6	42.3	59.1	72.5	144	63.1	65.4	92.2	112.1
95	41.1	42.7	59.7	73.3	145	63.6	65.9	92.8	112.9
96	41.5	43.2	60.4	74.1	146	64.0	66.4	93.5	113.7
97	42.0	43.7	61.1	74.9	147	64.5	66.9	94.2	114.5
98	42.4	44.1	61.7	75.7	148	65.0	67.3	94.8	115.3
99	42.9	44.6	62.4	76.5	149	65.4	67.8	95.5	116.1
00	43.3	45.0	63.0	77.3	150	65.9	68.3	96.1	116.9
01	43.8	45.5	63.7	78.1	151	66.3	68.7	96.8	117.7
02	44.2	46.0	64.4	78.8	152	66.8	69.2	97.5	118.5
03	44.7	46.4	65.0	79.6	153	67.2	69.7	98.1	119.3
04	45.1	46.9	65.7	80.4	154	67.7	70.1	98.8	120.0
05	45.5	47.3	66.4	81.2	155	68.2	70.6	99.5	120.8
06	46.0	47.8	67.0	82.0	156	68.6	71.1	100.1	121.6
07	46.4	48.3	67.7	82.8	157	69.1	71.6	100.8	122.4
08	46.9	48.7	68.3	83.6	158	69.5	72.0	101.5	123.2
09	47.3	49.2	69.0	84.4	159	70.0	72.5	102.1	124.0
10	47.8	49.6	69.7	85.2	160	70.4	73.0	102.8	124.8
11	48.2	50.1	70.3	86.0	161	70.9	73.4	103.4	125.6
12	48.7	50.6	71.0	86.8	162	71.4	73.9	104.1	126.4
13	49.1	51.0	71.6	87.6	163	71.8	74.4	104.8	127.2
14	49.6	51.5	72.3	88.4	164	72.3	74.9	105.4	128.0
15	50.0	51.9	73.0	89.2	165	72.8	75.3	106.1	128.8
16	50.5	52.4	73.6	90.0	166	73.2	75.8	106.8	129.6
17	50.9	52.9	74.3	90.7	167	73.7	76.3	107.4	130.3
18	51.4	53.3	75.0	91.5	168	74.1	76.8	108.1	131.1
19	51.8	53.8	75.6	92.3	169	74.6	77.2	108.8	131.9
20	52.3	54.3	76.3	93.1	170	75.1	77.7	109.4	132.7
21	52.7	54.7	76.9	93.9	171	75.5	78.2	110.1	133.5
22	53.2	55.2	77.6	94.7	172	76.0	78.7	110.8	134.3
23	53.6	55.7	78.3	95.5	173	76.4	79.1	111.4	135.1
24	54.1	56.1	78.9	96.3	174	76.9	79.6	112.1	135.9
25	54.5	56.6	79.6	97.1	175	77.4	80.1	112.8	136.7
26	55.0	57.0	80.3	97.9	176	77.8	80.6	113.4	137.5
27	55.4	57.5	80.9	98.7	177	78.3	81.0	114.1	138.3
28	55.9	58.0	81.6	99.4	178	78.8	81.5	114.8	139.1
29	56.3	58.4	82.2	100.2	179	79.2	82.0	115.4	139.8
30	56.8	58.9	82.9	101.0	180	79.7	82.5	116.1	140.6
31	57.2	59.4	83.6	101.8	181	80.1	82.9	116.7	141.4
32	57.7	59.8	84.2	102.6	182	80.6	83.4	117.4	142.2
33	58.1	60.3	84.9	103.4	183	81.1	83.9	118.1	143.0
34	58.6	60.8	85.5	104.2	184	81.5	84.4	118.7	143.8
35	59.0	61.2	86.2	105.0	185	82.0	84.9	119.4	144.6
36	59.5	61.7	86.9	105.8	186	82.5	85.3	120.1	145.4
37	60.0	62.2	87.5	106.6	187	82.9	85.8	120.7	146.2
38	60.4	62.6	88.2	107.4	188	83.4	86.3	121.4	147.0
39	60.9	63.1	88.9	108.2	189	83.9	86.8	122.1	147.8

CUPROUS OXIDE EQUIVALENT OF DEXTROSE, INVERT SUGAR, LACTOSE AND MALTOSE (Continued)

Cuprous Oxide Cu_2O	Dextrose $C_6H_{12}O_6$	Invert Sugar	Lactose $C_{12}H_{22}O_{11}$	Maltose $C_{12}H_{22}O_{11}$	Cuprous Oxide Cu_2O	Dextrose $C_6H_{12}O_6$	Invert Sugar	Lactose $C_{12}H_{22}O_{11}$	Maltose $C_{12}H_{22}O_{11}$
190	84.3	87.2	122.7	148.6	240	108.0	111.5	156.1	188.1
191	84.8	87.7	123.4	149.3	241	108.4	112.0	156.7	188.9
192	85.3	88.2	124.1	150.1	242	108.9	112.5	157.4	189.7
193	85.7	88.7	124.7	150.9	243	109.4	113.0	158.1	190.5
194	86.2	89.2	125.4	151.7	244	109.9	113.5	158.7	191.3
195	86.7	89.6	126.1	152.5	245	110.4	114.0	159.4	192.1
196	87.1	90.1	126.7	153.3	246	110.8	114.5	160.1	192.9
197	87.6	90.6	127.4	154.1	247	111.3	115.0	160.7	193.6
198	88.1	91.1	128.1	154.9	248	111.8	115.4	161.4	194.4
199	88.5	91.6	128.7	155.7	249	112.3	115.9	162.1	195.2
200	89.0	92.0	129.4	156.5	250	112.8	116.4	162.7	196.0
201	89.5	92.5	130.0	157.3	251	113.2	116.9	163.4	196.8
202	89.9	93.0	130.7	158.1	252	113.7	117.4	164.1	197.6
203	90.4	93.5	131.4	158.8	253	114.2	117.9	164.7	198.4
204	90.9	94.0	132.0	159.6	254	114.7	118.4	165.4	199.2
205	91.4	94.5	132.7	160.4	255	115.2	118.9	166.1	200.0
206	91.8	94.9	133.4	161.2	256	115.7	119.4	166.8	200.8
207	92.3	95.4	134.0	162.0	257	116.1	119.9	167.4	201.6
208	92.8	95.9	134.7	162.8	258	116.6	120.4	168.1	202.4
209	93.2	96.4	135.4	163.6	259	117.1	120.9	168.8	203.2
210	93.7	96.9	136.0	164.4	260	117.6	121.4	169.4	203.9
211	94.2	97.4	136.7	165.2	261	118.1	121.9	170.1	204.7
212	94.6	97.8	137.4	166.0	262	118.6	122.4	170.8	205.5
213	95.1	98.3	138.0	166.8	263	119.0	122.9	171.4	206.3
214	95.6	98.8	138.7	167.5	264	119.5	123.4	172.1	207.1
215	96.1	99.3	139.4	168.3	265	120.0	123.9	172.8	207.9
216	96.5	99.8	140.0	169.1	266	120.5	124.4	173.5	208.7
217	97.0	100.3	140.7	169.9	267	121.0	124.9	174.1	209.4
218	97.5	100.8	141.4	170.7	268	121.5	125.4	174.8	210.2
219	98.0	101.2	142.0	171.5	269	122.0	125.9	175.5	211.0
220	98.4	101.7	142.7	172.3	270	122.5	126.4	176.1	211.8
221	98.9	102.2	143.4	173.1	271	122.9	126.9	176.8	212.6
222	99.4	102.7	144.0	173.9	272	123.4	127.4	177.5	213.4
223	99.9	103.2	144.7	174.7	273	123.9	127.9	178.1	214.2
224	100.3	103.7	145.4	175.5	274	124.4	128.4	178.8	215.0
225	100.8	104.2	146.0	176.2	275	124.9	128.9	179.5	215.8
226	101.3	104.6	146.7	177.0	276	125.4	129.4	180.2	216.6
227	101.8	105.1	147.4	177.8	277	125.9	129.9	180.8	217.4
228	102.2	105.6	148.0	178.6	278	126.4	130.4	181.5	218.2
229	102.7	106.1	148.7	179.4	279	126.9	130.9	182.2	218.9
230	103.2	106.6	149.4	180.2	280	127.3	131.4	182.8	219.7
231	103.7	107.1	150.0	181.0	281	127.8	131.9	183.5	220.5
232	104.1	107.6	150.7	181.8	282	128.3	132.4	184.2	221.3
233	104.6	108.1	151.4	182.6	283	128.8	132.9	184.8	222.1
234	105.1	108.6	152.0	183.4	284	129.3	133.4	185.5	222.9
235	105.6	109.1	152.7	184.2	285	129.8	133.9	186.2	223.7
236	106.0	109.5	153.4	184.9	286	130.3	134.4	186.9	224.4
237	106.5	110.0	154.0	185.7	287	130.8	134.9	187.5	225.2
238	107.0	110.5	154.7	186.5	288	131.3	135.4	188.2	226.0
239	107.5	111.0	155.4	187.3	289	131.8	135.9	188.9	226.8

CUPROUS OXIDE EQUIVALENT OF DEXTROSE, INVERT SUGAR, LACTOSE AND MALTOSE (Continued)

Cuprous Oxide Cu_2O	Dextrose $C_6H_{12}O_6$	Invert Sugar	Lactose $C_{12}H_{22}O_{11}$	Maltose $C_{12}H_{22}O_{11}$	Cuprous Oxide Cu_2O	Dextrose $C_6H_{12}O_6$	Invert Sugar	Lactose $C_{12}H_{22}O_{11}$	Maltose $C_{12}H_{22}O_{11}$
290	132.3	136.4	189.5	227.6	340	157.3	162.0	223.2	267.1
291	132.7	136.9	190.2	228.4	341	157.8	162.5	223.8	267.9
292	133.2	137.4	190.9	229.2	342	158.3	163.1	224.5	268.7
293	133.7	137.9	191.5	230.0	343	158.8	163.6	225.2	269.5
294	134.2	138.4	192.2	230.8	344	159.3	164.1	225.9	270.3
295	134.7	138.9	192.9	231.6	345	159.8	164.6	226.5	271.1
296	135.2	139.4	193.6	232.4	346	160.3	165.1	227.2	271.9
297	135.7	140.0	194.2	233.2	347	160.8	165.7	227.9	272.7
298	136.2	140.5	194.9	234.0	348	161.4	166.2	228.5	273.5
299	136.7	141.0	195.6	234.8	349	161.9	166.7	229.2	274.3
300	137.2	141.5	196.2	235.5	350	162.4	167.2	229.9	275.0
301	137.7	142.0	196.9	236.3	351	162.9	167.7	230.6	275.8
302	138.2	142.5	197.6	237.1	352	163.4	168.3	231.2	276.6
303	138.7	143.0	198.3	237.9	353	163.9	168.8	231.9	277.4
304	139.2	143.5	198.9	238.7	354	164.4	169.3	232.6	278.2
305	139.7	144.0	199.6	239.5	355	164.9	169.8	233.3	279.0
306	140.2	144.5	200.3	240.3	356	165.4	170.4	233.9	279.8
307	140.7	145.0	201.0	241.1	357	166.0	170.9	234.6	280.6
308	141.2	145.5	201.6	241.9	358	166.5	171.4	235.3	281.4
309	141.7	146.1	202.3	242.7	359	167.0	171.9	236.0	282.2
310	142.2	146.6	203.0	243.5	360	167.5	172.5	236.7	282.9
311	142.7	147.1	203.6	244.2	361	168.0	173.0	237.3	283.7
312	143.2	147.6	204.3	245.0	362	168.5	173.5	238.0	284.5
313	143.7	148.1	205.0	245.8	363	169.0	174.0	238.7	285.3
314	144.2	148.6	205.7	246.6	364	169.6	174.6	239.4	286.1
315	144.7	149.1	206.3	247.4	365	170.1	175.1	240.0	286.9
316	145.2	149.6	207.0	248.2	366	170.6	175.6	240.7	287.7
317	145.7	150.1	207.7	249.0	367	171.1	176.1	241.4	288.5
318	146.2	150.7	208.4	249.8	368	171.6	176.7	242.1	289.3
319	146.7	151.2	209.0	250.6	369	172.1	177.2	242.7	290.0
320	147.2	151.7	209.7	251.3	370	172.7	177.7	243.4	290.8
321	147.7	152.2	210.4	252.1	371	173.2	178.3	244.1	291.6
322	148.2	152.7	211.0	252.9	372	173.7	178.8	244.8	292.4
323	148.7	153.2	211.7	253.7	373	174.2	179.3	245.4	293.2
324	149.2	153.7	212.4	254.5	374	174.7	179.8	246.1	294.0
325	149.7	154.3	213.1	255.3	375	175.3	180.4	246.8	294.8
326	150.2	154.8	213.7	256.1	376	175.8	180.9	247.5	295.6
327	150.7	155.3	214.4	256.9	377	176.3	181.4	248.1	296.4
328	151.2	155.8	215.1	257.7	378	176.8	182.0	248.8	297.2
329	151.7	156.3	215.8	258.5	379	177.3	182.5	249.5	297.9
330	152.2	156.8	216.4	259.3	380	177.9	183.0	250.2	298.7
331	152.7	157.3	217.1	260.0	381	178.4	183.6	250.8	299.5
332	153.2	157.9	217.8	260.8	382	178.9	184.1	251.5	300.3
333	153.7	158.4	218.4	261.6	383	179.4	184.6	252.2	301.1
334	154.2	158.9	219.1	262.4	384	180.0	185.2	252.9	301.9
335	154.7	159.4	219.8	263.2	385	180.5	185.7	253.6	302.7
336	155.2	159.9	220.5	264.0	386	181.0	186.2	254.2	303.5
337	155.8	160.5	221.1	264.8	387	181.5	186.8	254.9	304.2
338	156.3	161.0	221.8	265.6	388	182.0	187.3	255.6	305.0
339	156.8	161.5	222.5	266.4	389	182.6	187.8	256.3	305.8

CUPROUS OXIDE EQUIVALENT OF DEXTROSE, INVERT SUGAR, LACTOSE AND MALTOSE (Continued)

Cuprous Oxide Cu_2O	Dextrose $C_6H_{12}O_6$	Invert Sugar	Lactose $C_{12}H_{22}O_{11}$	Maltose $C_{12}H_{22}O_{11}$	Cuprous Oxide Cu_2O	Dextrose $C_6H_{12}O_6$	Invert Sugar	Lactose $C_{12}H_{22}O_{11}$	Maltose $C_{12}H_{22}O_{11}$
390	183.1	188.4	256.9	306.6	440	209.8	215.5	290.9	346.1
391	183.6	188.9	257.6	307.4	441	210.3	216.1	291.5	346.8
392	184.1	189.4	258.3	308.2	442	210.9	216.6	292.2	347.6
393	184.7	190.0	259.0	309.0	443	211.4	217.2	292.9	348.4
394	185.2	190.5	259.6	309.8	444	212.0	217.8	293.6	349.2
395	185.7	191.0	260.3	310.6	445	212.5	218.3	294.2	350.0
396	186.2	191.6	261.0	311.4	446	213.1	218.9	294.9	350.8
397	186.8	192.1	261.7	312.1	447	213.6	219.4	295.6	351.6
398	187.3	192.7	262.3	312.9	448	214.1	220.0	296.3	352.4
399	187.8	193.2	263.0	313.7	449	214.7	220.5	297.0	353.2
400	188.4	193.7	263.7	314.5	450	215.2	221.1	297.6	353.9
401	188.9	194.3	264.4	315.3	451	215.8	221.6	298.3	354.7
402	189.4	194.8	265.0	316.1	452	216.3	222.2	299.0	355.5
403	189.9	195.4	265.7	316.9	453	216.9	222.8	299.7	356.3
404	190.5	195.9	266.4	317.7	454	217.4	223.3	300.4	357.1
405	191.0	196.4	267.1	318.5	455	218.0	223.9	301.1	357.9
406	191.5	197.0	267.8	319.2	456	218.5	224.4	301.7	358.7
407	192.1	197.5	268.4	320.0	457	219.1	225.0	302.4	359.5
408	192.6	198.1	269.1	320.8	458	219.6	225.5	303.1	360.3
409	193.1	198.6	269.8	321.6	459	220.2	226.1	303.8	361.0
410	193.7	199.1	270.5	322.4	460	220.7	226.7	304.5	361.8
411	194.2	199.7	271.2	323.2	461	221.3	227.2	305.1	362.6
412	194.7	200.2	271.8	324.0	462	221.8	227.8	305.8	363.4
413	195.2	200.8	272.5	324.8	463	222.4	228.3	306.5	364.2
414	195.8	201.3	273.2	325.6	464	222.9	228.9	307.2	365.0
415	196.3	201.8	273.9	326.3	465	223.5	229.5	307.9	365.8
416	196.8	202.4	274.6	327.1	466	224.0	230.0	308.6	366.6
417	197.4	202.9	275.2	327.9	467	224.6	230.6	309.2	367.3
418	197.9	203.5	275.9	328.7	468	225.1	231.2	309.9	368.1
419	198.4	204.0	276.6	329.5	469	225.7	231.7	310.6	368.9
420	199.0	204.6	277.3	330.3	470	226.2	232.3	311.3	369.7
421	199.5	205.1	277.9	331.1	471	226.8	232.8	312.0	370.5
422	200.1	205.7	278.6	331.9	472	227.4	233.4	312.6	371.3
423	200.6	206.2	279.3	332.7	473	227.9	234.0	313.3	372.1
424	201.1	206.7	280.0	333.4	474	228.5	234.5	314.0	372.9
425	201.7	207.3	280.7	334.2	475	229.0	235.1	314.7	373.7
426	202.2	207.8	281.3	335.0	476	229.6	235.7	315.4	374.4
427	202.8	208.4	282.0	335.8	477	230.1	236.2	316.1	375.2
428	203.3	208.9	282.7	336.6	478	230.7	236.8	316.7	376.0
429	203.8	209.5	283.4	337.4	479	231.3	237.4	317.4	376.8
430	204.4	210.0	284.1	338.2	480	231.8	237.9	318.1	377.6
431	204.9	210.6	284.7	339.0	481	232.4	238.5	318.8	378.4
432	205.5	211.1	285.4	339.7	482	232.9	239.1	319.5	379.2
433	206.0	211.7	286.1	340.5	483	233.5	239.6	320.1	380.0
434	206.5	212.2	286.8	341.3	484	234.1	240.2	320.8	380.7
435	207.1	212.8	287.5	342.1	485	234.6	240.8	321.5	381.5
436	207.6	213.3	288.1	342.9	486	235.2	241.4	322.2	382.3
437	208.2	213.9	288.8	343.7	487	235.7	241.9	322.9	383.1
438	208.7	214.4	289.5	344.5	488	236.3	242.5	323.6	383.9
439	209.2	215.0	290.2	345.3	489	236.9	243.1	324.2	384.7
					490	237.4	243.6	324.5	385.5

CONDENSED TABLE OF GRAVIMETRIC FACTORS AND THEIR LOGARITHMS

Weighed.	Sought.	Factor.	Logarithm −10.
AgBr	Ag	0.57445	9.75925
	Br	0.42555	9.62895
	HBr	0.43091	9.63439
AgCl	Ag	0.75263	9.87658
	Cl	0.24737	9.39334
	HCl	0.25450	9.40552
AgI	I	0.54056	9.73285
	HI	0.54486	9.73629
Al_2O_3	Al	0.52914	9.72357
As_2O_3	As	0.75748	9.87937
As_2S_3	As_2O_3	0.80420	9.90536
$BaSO_4$	Ba	0.58848	9.76973
	BaO	0.65702	9.81758
	H_2SO_4	0.42016	9.62342
	S	0.13736	9.13786
	SO_2	0.27444	9.43845
	SO_3	0.34299	9.53528
	SO_4	0.41153	9.61440
Bi_2O_3	Bi	0.89700	9.95279
CaO	Ca	0.71465	9.85409
$CaSO_4$	Ca	0.29434	9.46885
	CaO	0.41187	9.61476
CdO	Cd	0.87540	9.94221
CoO	Co	0.78650	9.89570
CO_2	C	0.27273	9.43573
Cr_2O_3	Cr	0.68426	9.83522
	CrO_3	1.3157	10.11917
	CrO_4	1.5263	10.18362
CuO	Cu	0.79891	9.90250
Fe_2O_3	Fe	0.69940	9.84473
	FeO	0.89980	9.95415
H_2O	H	0.11190	9.04884
HgS	Hg	0.86220	9.93561
K_2PtCl_6	K	0.16084	9.20639
	K_2O	0.19375	9.28723
K_2SO_4	K	0.44871	9.65196
	K_2O	0.54053	9.73282
Li_3PO_4	Li	0.17972	9.25460
$Mg_2As_2O_7$	As_2O_3	0.63730	9.80434
$Mg_2P_2O_7$	Mg	0.21842	9.33928
	MgO	0.36211	9.55884
	P	0.27865	9.44506
	PO_4	0.85344	9.93117
	P_2O_5	0.63789	9.80474
$MnSO_4$	Mn	0.36379	9.56086

CONDENSED TABLE OF GRAVIMETRIC FACTORS AND THEIR LOGARITHMS (Continued)

Weighed.	Sought.	Factor.	Logarithm −10
Mn_3O_4	Mn	0.72026	9.85749
MoO_2	Mo	0.75000	9.87506
Na_2SO_4	Na	0.32377	9.51024
	Na_2O	0.43641	9.63989
$(NH_4)_2PtCl_6$	N	0.063093	8.79998
	NH_3	0.076712	8.88486
NiO	Ni	0.78578	9.89530
$NiSO_4$	Ni	0.37925	9.57892
$PbCrO_4$	Cr	0.16092	9.20661
PbO	Pb	0.92832	9.96770
PbS	Pb	0.86598	9.93751
$PbSO_4$	Pb	0.68323	9.83457
Pt	N	0.14350	9.15686
	NH_3	0.17448	9.24174
Sb_2O_4	Sb	0.79188	9.89866
Sb_2S_3	Sb	0.71685	9.85543
SiO_2	Si	0.46720	9.66950
$SrCO_3$	Sr	0.59357	9.77347
	SrO	0.70195	9.84631
$SrSO_4$	Sr	0.47703	9.67855
	SrO	0.56414	9.75139
TiO_2	Ti	0.60051	9.77852
U_3O_8	U	0.84806	9.92843
WO_3	W	0.79310	9.89933
ZnO	Zn	0.80338	9.90492
ZnS	Zn	0.67093	9.82668
	ZnO	0.83514	9.92176

GRAVIMETRIC FACTORS AND THEIR LOGARITHMS

Computed from the atomic weights of 1925 by Irwin C. Clare and Eric A. Arnold, structors in Chemistry at Case School of Applied Science.

To facilitate the use of the table the group of substances weighed given under each ement as well as the substances sought under each substance weighed are arranged the alphabetical order of their formulae.

Weighed	Sought	Factor	Logarithm
luminum Al = 26.97			−10
Al.....	Al_2O_3.....	1.8899	10.27643
	$AlPO_4$.....	4.5234	10.65547
Al_4C_3....	Al_2O_3.....	1.4170	10.15137
$AlCl_3$....	Al_2O_3.....	0.38225	9.58235
AlF_3....	CaF_2.....	1.3946	10.14445
Al_2O_3....	Al.....	0.52914	9.72357
	Al_4C_3.....	0.70571	9.84863
	$AlCl_3$.....	2.6161	10.41765
	$AlPO_4$.....	2.3936	10.37904
	$Al_2(SO_4)_3$...	3.3562	10.52585
	$Al_2(SO_4)_3 \cdot 18H_2O$..	6.5373	10.81540
	$K_2SO_4 \cdot Al_2(SO_4)_3 \cdot 24H_2O$..	9.3072	10.96882
	$(NH_4)_2SO_4 \cdot Al_2(SO_4)_3 \cdot 24H_2O$	8.8940	10.94910
$AlPO_4$....	Al	0.22107	9.34453
	Al_2O_3	0.41779	9.62096
	P_2O_5	0.58220	9.76507
$Al_2(SO_4)_3$	Al_2O_3	0.29795	9.47415
$Al_2(SO_4)_3 \cdot 18H_2O$.	Al_2O_3	0.15297	9.18460
CaF_2	AlF_3	0.71705	9.85555
$K_2SO_4 \cdot Al_2(SO_4)_3 \cdot 24H_2O$	Al_2O_3	0.10744	9.03118
$(NH_4)_2SO_4 \cdot Al_2(SO_4)_3 \cdot 24H_2O$.	Al_2O_3.....	0.11244	9.05090
P_2O_5....	$AlPO_4$.....	1.7176	10.23493
Ammonium: NH_4 = 18.040			
Ag.....	NH_4Br.....	0.90800	9.95809
	NH_4Cl.....	0.49590	9.69539
	NH_4I.....	1.3438	10.12835
AgBr....	NH_4Br.....	0.52160	9.71734
AgCl....	NH_4Cl.....	0.37323	9.57197
AgI.....	NH_4I.....	0.61740	9.79057
$BaSO_4$...	$(NH_4)_2SO_4$..	0.56610	9.75289
Br.....	NH_4Br.....	1.2257	10.08839
Cl.....	NH_4.....	0.50879	9.70654
	NH_4Cl.....	1.5088	10.17863
HCl....	NH_4Cl.....	1.4671	10.16645
I.....	NH_4I.....	1.1421	10.05772
$MgNH_4PO_4 \cdot 6H_2O$..	NH_3.....	0.069381	8.84124
Ammonium: $MgNH_4PO_4 \cdot 6H_2O$..	NH_4.....	0.073488	8.86622
	$(NH_4)_2O$ ...	0.10608	9.02562
N.....	NH_3.....	1.2158	10.08477
	NH_4.....	1.2877	10.10980
	NH_4Cl.....	3.8190	10.58195
	NH_4NO_3...	5.7138	10.75693
	$(NH_4)_2O$ ...	1.8587	10.26920
	$(NH_4)_2SO_4$..	4.7167	10.67364
NH_3....	$MgNH_4PO_4 \cdot 6H_2O$....	14.413	11.15876
	N.....	0.82268	9.91523
	NH_4.....	1.0592	
	NH_4Cl.....	3.1410	10.49707
	$(NH_4)_2CO_3$.	2.8206	10.45034
	NH_4HCO_3..	4.6412	10.66663
	NH_4NO_3...	4.6994	10.67204
	$(NH_4)_2O$ ...	1.5288	10.18435
	NH_4OH....	2.0577	10.31338
	$(NH_4)_2PtCl_6$....	13.036	11.11514
	$(NH_4)_2SO_4$..	3.8794	10.58876
	N_2O_5.....	3.1714	10.50126
	Pt.....	5.7314	10.75826
	SO_3.....	2.3505	10.37115
NH_4..	Cl.....	1.9655	10.29346
	$MgNH_4PO_4 \cdot 6H_2O$	13.608	11.13378
	N.....	0.77660	9.89020
	NH_3.....	0.94412	9.97503
	NH_4Cl.....	2.9655	10.47209
	$(NH_4)_2PtCl_6$	12.307	11.09016
	Pt.....	5.4110	10.73328
NH_4Br..	Ag.....	1.1013	10.04191
	AgBr.....	1.9172	10.28266
	Br.....	0.81585	9.91161
NH_4Cl..	Ag.....	2.0166	10.30461
	AgCl.....	2.6794	10.42803
	Cl.....	0.66278	9.82137
	HCl.....	0.68163	9.83355
	N.....	0.26185	9.41805
	NH_3.....	0.31837	9.50293
	NH_4.....	0.33722	9.52791
	$(NH_4)_2O$ ...	0.48676	9.68731
	NH_4OH....	0.65513	9.81633
	$(NH_4)_2PtCl_6$	4.1502	10.61807
	Pt.....	1.8247	10.26119
$(NH_4)_2CO_3$...	NH_3.....	0.35453	9.54966
NH_4HCO_3.	NH_3.....	0.21546	9.33337

GRAVIMETRIC FACTORS AND THEIR LOGARITHMS
(Continued)

Weighed	Sought	Factor	Logarithm	Weighed	Sought	Factor	Logarithm
Ammonium:			−10	Antimony $KSbOC_4H_4O_6 \cdot \frac{1}{2}H_2O$			−10
NH_4I	Ag	0.74413	9.87165		Sb_2O_4	0.46052	9.6632
	AgI	1.6197	10.20943		Sb_2S_3	0.50872	9.7064
	I	0.87554	9.94228	Sb	$KSbOC_4H_4O_6 \cdot \frac{1}{2}H_2O$	2.7421	10.4380
NH_4NO_3	NH_3	0.21274	9.32785		Sb_2O_3	1.1971	10.0781
	$(NH_4)_2PtCl_6$	2.7736	10.44305		Sb_2O_4	1.2628	10.1013
	N_2O_5	0.67470	9.82911		Sb_2O_5	1.3285	10.1233
	Pt	1.2195	10.08617		Sb_2S_3	1.3650	10.1445
$(NH_4)_2O$	$MgNH_4PO_4 \cdot 6H_2O$	9.4272	10.97438		Sb_2S_5	1.6583	10.2196
	NH_4Cl	2.0544	10.31269	Sb_2O_3	$KSbOC_4H_4O_6 \cdot \frac{1}{2}H_2O$	2.2906	10.3599
	N	0.5386	9.73080		Sb	0.83536	9.9218
	NH_3	0.65418	9.81570		Sb_2O_4	1.0549	10.0232
	$(NH_4)_2PtCl_6$	8.5262	10.93076		Sb_2O_5	1.1008	10.0452
	N_2O_5	2.0741	10.31683		Sb_2S_3	1.1653	10.0664
	Pt	3.7487	10.57388		Sb_2S_5	1.3853	10.1415
NH_4OH	N	0.39971	9.60175	Sb_2O_4	$KSbOC_4H_4O_6 \cdot \frac{1}{2}H_2O$	2.1715	10.3367
	NH_3	0.48599	9.68663		Sb	0.70188	9.8986
	NH_4	0.51475	9.71160		Sb_2O_3	0.94796	9.9767
	NH_4Cl	1.5264	10.18367		Sb_2O_5	1.0520	10.0220
	$(NH_4)_2PtCl_6$	6.3349	10.80174		Sb_2S_3	1.1047	10.0432
	Pt	2.7852	10.44486		Sb_2S_5	1.3132	10.1183
$(NH_4)_2PtCl_6$	NH_3	0.076712	8.88486	Sb_2O_5	Sb	0.75273	9.8766
	NH_4	0.081253	8.90984		Sb_2O_3	0.90110	9.9547
	NH_4Cl	0.24095	9.38193		Sb_2O_4	0.95056	9.9779
	NH_4NO_3	0.36053	9.55695		Sb_2S_5	1.2483	10.0963
	$(NH_4)_2O$	0.11729	9.06924	Sb_2S_3	$KSbOC_4H_4O_6 \cdot \frac{1}{2}H_2O$	1.9657	10.2935
	NH_4OH	0.15786	9.19826		Sb	0.71685	9.8554
	$(NH_4)_2SO_4$	0.29759	9.47362		Sb_2O_3	0.85814	9.9333
$(NH_4)_2SO_4$	$BaSO_4$	1.7665	10.24711		Sb_2O_4	0.90526	9.9567
	H_2SO_4	0.74222	9.87053		Sb_2O_5	0.95234	9.9787
	N	0.21201	9.32636		Sb_2S_5	0.60303	9.7803
	NH_3	0.25778	9.41124	Sb_2S_5	Sb	0.72188	9.8584
	$(NH_4)_2PtCl_6$	3.3603	10.52638		Sb_2O_3	0.76152	9.8816
	Pt	1.4774	10.16950		Sb_2O_4	0.80112	9.9037
	SO_3	0.80589	9.78239				
N_2O_5	NH_3	0.31531	9.49874	Arsenic: As = 74.96			
	NH_4NO_3	1.4821	10.17086				
	$(NH_4)_2O$	0.48214	9.68317				
Pt	NH_3	0.17448	9.24174	As	As_2O_3	1.3202	10.1206
	NH_4	0.18481	9.26672		As_2O_5	1.5336	10.1857
	NH_4Cl	0.54804	9.73881		As_2S_3	1.6416	10.2153
	NH_4NO_3	0.82003	9.91353		As_2S_5	2.0694	10.3157
	$(NH_4)_2O$	0.26676	9.42612		$BaSO_4$	4.6711	10.6694
	NH_4OH	0.35904	9.55514		$Mg_2As_2O_7$	2.0715	10.3163
	$(NH_4)_2SO_4$	0.67687	9.83050		$MgNH_4AsO_4 \cdot \frac{1}{2}H_2O$	1.9227	10.2841
SO_3	NH_3	0.42545	9.62885				
	$(NH_4)_2SO_4$	1.6505	10.21761				
Antimony Sb = 121.77				As_2O_3	As	0.75748	9.8794
					As_2O_5	1.1616	10.0653
					As_2S_3	1.2435	10.0945
					As_2S_5	1.5675	10.1951
$KSbOC_4H_4O_6 \cdot \frac{1}{2}H_2O$	Sb	0.36468	9.56191		$BaSO_4$	3.5383	10.5487
	Sb_2O_3	0.43656	9.64004		$Mg_2As_2O_7$	1.5691	10.1955

GRAVIMETRIC FACTORS AND THEIR LOGARITHMS
(Continued)

Weighed	Sought	Factor	Logarithm
senic:			−10
As_2O_3 . . .	$MgNH_4AsO_4 \cdot \frac{1}{2}H_2O$	1.9227	10.28405
As_2O_5	As	0.65203	9.81429
	As_2O_3	0.86082	9.93491
	As_2S_3	1.0705	10.02955
	As_2S_5	1.3493	10.13012
	$BaSO_4$	3.0458	10.48370
	$Mg_2As_2O_7$ . .	1.3504	10.13057
	$MgNH_4AsO_4 \cdot \frac{1}{2}H_2O$	1.6556	10.21897
As_2O_3	$BaSO_4$	2.8476	10.45448
	$Mg_2As_2O_7$ . .	1.2629	10.10136
	$MgNH_4AsO_4 \cdot \frac{1}{2}H_2O$	1.5479	10.18975
As_2O_4	$BaSO_4$	2.5198	10.40136
	$Mg_2As_2O_7$ . .	1.1175	10.04823
	$MgNH_4AsO_4 \cdot \frac{1}{2}H_2O$	1.3700	10.13672
As_2S_3	As	0.60916	9.78473
	As_2O_3	0.80420	9.90536
	As_2O_5	0.93422	9.97045
	As_2S_5	1.2606	10.10057
	$Mg_2As_2O_7$ . .	1.2619	10.10101
As_2S_5	As	0.48323	9.68416
	As_2O_3	0.63796	9.80479
	As_2O_5	0.74110	9.86988
	As_2S_3	0.79330	9.89944
$BaSO_4$ . . .	As	0.21408	9.33058
	As_2O_3	0.28263	9.45121
	As_2O_5	0.32832	9.51630
	AsO_3	0.35118	9.54552
	AsO_4	0.39686	9.59864
$Mg_2As_2O_7$	As	0.48273	9.68371
	As_2O_3	0.63730	9.80434
	As_2O_5	0.74033	9.86943
	AsO_3	0.79183	9.89864
	AsO_4	0.89490	9.95177
	As_2S_3	0.79248	9.89899
$MgNH_4AsO_4 \cdot \frac{1}{2}H_2O$ . .	As	0.39383	9.59532
	As_2O_3	0.51993	9.71595
	As_2O_5	0.60399	9.78103
	AsO_3	0.64603	9.81025
	AsO_4	0.72993	9.86328
arium: Ba = 137.37			
Ba	$BaCO_3$	1.4368	10.15739
	$BaCrO_4$	1.8445	10.26589
	$BaSiF_6$	2.0342	10.30839
	$BaSO_4$	1.6993	10.23027
$BaCl_2$ . . .	$BaCO_3$	0.94758	9.97662

Weighed	Sought	Factor	Logarithm
Barium:			−10
$BaCl_2$ . . .	$BaCrO_4$	1.2165	10.08512
	$BaSO_4$	1.1207	10.04950
$BaCl_2 \cdot 2H_2O$ . .	$BaSO_4$	0.95545	9.98021
$BaCO_3$ . .	Ba	0.69600	9.84261
	$BaCl_2$	1.0553	10.02338
	$BaCrO_4$	1.2838	10.10850
	$Ba(HCO_3)_2$ . .	1.3142	10.11867
	BaO	0.77707	9.89046
	$BaSO_4$	1.1827	10.07288
	CO_2	0.22293	9.34817
$BaCrO_4$ . .	Ba	0.54214	9.73411
	$BaCl_2$	0.82202	9.91488
	$BaCO_3$	0.77893	9.89150
	BaO	0.60529	9.78196
BaF_2	$BaSiF_6$	1.5934	10.20232
$Ba(HCO_3)_2$ . .	$BaCO_3$	0.76090	9.88133
$Ba(NO_3)_2$	$BaSO_4$	0.89304	9.95087
BaO	$BaCO_3$	1.2869	10.10954
	$BaCrO_4$	1.6521	10.21804
	$BaSiF_6$	1.8220	10.26054
	$BaSO_4$	1.5220	10.18242
	CO_2	0.28689	9.45771
BaO_2	$BaSO_4$	1.3782	10.13932
BaS	$BaSO_4$	1.3777	10.13916
$BaSiF_6$ . .	Ba	0.49160	9.69161
	BaF_2	0.62760	9.79768
	BaO	0.54886	9.73946
$BaSO_4$ . . .	Ba	0.58848	9.76973
	$BaCl_2$	0.89228	9.95050
	$BaCl_2 \cdot 2H_2O$	1.0466	10.01979
	$BaCO_3$	0.84552	9.92712
	$Ba(NO_3)_2$ . . .	1.1198	10.04913
	BaO	0.65702	9.81758
	BaO_2	0.72557	9.86068
	BaS	0.72583	9.86084
CO_2	BaO	3.4857	10.54229
	$BaCO_3$	4.4857	10.65183
Beryllium: (Glucinum) Be = 9.02			
BeO	Be	0.36051	9.55692
	$BeCl_2$	3.1948	10.50444
	$BeSO_4 \cdot 4H_2O$	7.0803	10.85005
Be	BeO	2.7738	10.44308
$BeCl_2$	BeO	0.31301	9.49556
$BeSO_4 \cdot 4H_2O$ . .	BeO	0.14124	9.14996
Bismuth: Bi = 209.00			
Bi	Bi_2O_3	1.1148	10.04721
	$BiAsO_4$	1.6649	10.22139
	BiOCl	1.2462	10.09559

GRAVIMETRIC FACTORS AND THEIR LOGARITHMS
(Continued)

Weighed	Sought	Factor	Logarithm
Bismuth:			−10
Bi	Bi_2S_3	1.2301	10.08994
$BiAsO_4$	Bi	0.60064	9.77862
	Bi_2O_3	0.66962	9.82583
$Bi(NO_3)_3 \cdot 5H_2O$	Bi_2O_3	0.48032	9.68153
	BiOCl	0.53693	9.72991
Bi_2O_3	Bi	0.89700	9.95279
	$BiAsO_4$	1.4934	10.17418
	BiOCl	1.1178	10.04838
	$Bi(NO_3)_3 \cdot 5H_2O$	2.0820	10.31847
	$BiONO_3$	1.2318	10.09053
	Bi_2S_3	1.1034	10.04273
BiOCl	Bi	0.80243	9.90441
	$Bi(NO_3)_3 \cdot 5H_2O$	1.8625	10.27009
	Bi_2O_3	0.89458	9.95162
	$BiONO_3$	1.1019	10.04215
$BiONO_3$	Bi_2O_3	0.81184	9.90947
	BiOCl	0.90750	9.95785
Bi_2S_3	Bi	0.81294	9.91006
	Bi_2O_3	0.90630	9.95727
Boron: B = 10.82			
B	B_2O_3	3.2181	10.50760
	KBF_4	11.637	11.06585
B_2O_3	B	0.31074	9.49240
	BO_2	1.2298	10.08983
	BO_3	1.6893	10.22771
	B_4O_7	1.1149	10.04724
	H_3BO_3	1.7761	10.24947
	KBF_4	3.6162	10.55825
	$Na_2B_4O_7 \cdot 10H_2O$	2.7386	10.43753
BO_2	B_2O_3	0.81317	9.91018
BO_3	B_2O_3	0.59198	9.77231
B_4O_7	B_2O_3	0.89696	9.95277
H_3BO_3	B_2O_3	0.56303	9.75053
	KBF_4	2.0360	10.30878
KBF_4	B	0.085932	8.93415
	B_2O_3	0.27653	9.44175
	H_3BO_3	0.49116	9.69122
	$Na_2B_4O_7 \cdot 10H_2O$	0.75732	9.87928
$Na_2B_4O_7 \cdot 10H_2O$	B_2O_3	0.36515	9.56247
	KBF_4	1.3204	10.12071
Bromine: Br = 79.916			
Ag	Br	0.74080	9.86970
	BrO_3	1.1857	10.07398
	HBr	0.75013	9.87514
AgBr	Br	0.42555	9.62895
	BrO_3	0.68113	9.83323
	HBr	0.43091	9.63439
AgCl	Br	0.55754	9.74628
Bromine:			−10
Br	Ag	1.3499	10.13030
	AgBr	2.3499	10.37104
	AgCl	1.7936	10.25374
	O	0.10010	9.00043
BrO_3	Ag	0.84338	9.92603
	AgBr	1.4681	10.16677
HBr	Ag	1.3331	10.12484
	AgBr	2.3206	10.36560
O	Br	9.9896	10.99954
Cadmium: Cd = 112.41			
Cd	$CdCl_2$	1.6308	10.21244
	$Cd(NO_3)_2$	2.1032	10.32285
	CdO	1.1423	10.05774
	CdS	1.2852	10.10894
	$CdSO_4$	1.8546	10.26824
$CdCl_2$	Cd	0.61319	9.78754
	CdO	0.70045	9.84534
	CdS	0.78808	9.89654
	$CdSO_4$	1.1372	10.05584
$Cd(NO_3)_2$	Cd	0.47546	9.67714
	CdO	0.54313	9.73494
	CdS	0.61107	9.78604
	$CdSO_4$	0.88178	9.94534
CdO	Cd	0.87540	9.94224
	$CdCl_2$	1.4276	10.15464
	$Cd(NO_3)_2$	1.8412	10.26514
	CdS	1.1251	10.05114
	$CdSO_4$	1.6235	10.21044
CdS	Cd	0.77807	9.89104
	$CdCl_2$	1.2689	10.10344
	$Cd(NO_3)_2$	1.6365	10.21394
	CdO	0.88882	9.94884
	$CdSO_4$	1.4430	10.15924
$CdSO_4$	Cd	0.53920	9.73174
	$CdCl_2$	0.87934	9.94414
	$Cd(NO_3)_2$	1.1341	10.05464
	CdO	0.61594	9.78954
	CdS	0.69301	9.84074
Caesium: Cs = 132.81			
AgCl	CsCl	1.1739	10.06964
Cl	Cs	3.7457	10.57354
	CsCl	4.7457	10.67634
Cs	Cl	0.26698	9.42644
	CsCl	1.2670	10.10274
	Cs_2CO_3	1.2259	10.08844
	Cs_2O	1.0602	10.02534
	Cs_2PtCl_6	2.5359	10.40414
	Cs_2SO_4	1.3617	10.13404
CsCl	AgCl	0.85184	9.93034
	Cl	0.21072	9.32374
	Cs	0.78928	9.89724
	Cs_2O	0.83682	9.92264
	Cs_2PtCl_6	2.0016	10.30134

GRAVIMETRIC FACTORS AND THEIR LOGARITHMS
(Continued)

Weighed	Sought	Factor	Logarithm
Caesium:			−10
CsCl	Cs_2SO_4	1.0747	10.03129
Cs_2CO_3	Cs	0.81574	9.91155
	Cs_2PtCl_6	2.0686	10.31568
	Cs_2SO_4	1.1108	10.04564
Cs_2O	Cs	0.94319	9.97460
	CsCl	1.1950	10.07737
	Cs_2SO_4	1.2843	10.10867
	Cs_2PtCl_6	2.3918	10.37872
	SO_3	0.28430	9.45378
Cs_2PtCl_6	Cs	0.39433	9.59586
	CsCl	0.49961	9.69863
	Cs_2CO_3	0.48341	9.68432
	Cs_2O	0.41809	9.62127
Cs_2SO_4	Cs	0.73440	9.86593
	CsCl	0.93046	9.96870
	Cs_2CO_3	0.90029	9.95438
	Cs_2O	0.77864	9.89134
SO_3	Cs_2O	3.5174	10.54622
Calcium: Ca = 40.07			
$BaSO_4$	CaS	0.30901	9.48998
	$CaSO_4$	0.58319	9.76581
	$CaSO_4 \cdot 2H_2O$	0.73755	9.86779
Ca	$CaCl_2$	2.7698	10.44244
	$CaCO_3$	2.4974	10.39748
	CaF_2	1.9483	10.28966
	CaO	1.3993	10.14591
	$CaSO_4$	3.3974	10.53115
	Cl	1.7698	10.24791
$Ca_3(AsO_4)_2$	$Mg_2As_2O_7$	0.77995	9.89207
$CaCl_2$	Ca	0.36104	9.55756
	$CaCO_3$	0.90166	9.95504
	CaO	0.50521	9.70347
	$CaSO_4$	1.2266	10.08871
	Cl	0.63896	9.80547
$CaCO_3$	Ca	0.40043	9.60252
	$CaCl_2$	1.1091	10.04496
	$Ca(HCO_3)_2$	1.6197	10.20944
	CaO	0.56031	9.74843
	$CaSO_4$	1.3604	10.13367
	$CaSO_4 \cdot 2H_2O$	1.7205	10.23565
	CO_2	0.43969	9.64315
	HCl	0.72880	9.86261
CaF_2	Ca	0.51325	9.71033
	$CaSO_4$	1.7438	10.24149
$Ca(HCO_3)_2$	$CaCO_3$	0.61739	9.79056
	CaO	0.34593	9.53899
$Ca(NO_3)_2$	N_2O_5	0.65830	9.81842
CaO	Ca	0.71465	9.85409
	$CaCl_2$	1.9794	10.29653
	$CaCO_3$	1.7847	10.25157
	CaF_2	1.3924	10.14376
	$Ca(HCO_3)_2$	2.8907	10.46101
Calcium:			−10
CaO	$Ca_3(PO_4)_2$	1.8445	10.26588
	$CaSO_4$	2.4279	10.38524
	$CaSO_4 \cdot 2H_2O$	3.0706	10.48722
	Cl	1.2647	10.10200
	CO_2	0.78473	9.89472
	MgO	0.71910	9.85679
	SO_3	1.4279	10.15471
$Ca_3(PO_4)_2$	CaO	0.54215	9.73412
	$CaSO_4$	1.3163	10.11936
	$Mg_2P_2O_7$	0.71777	9.85598
	$(NH_4)_3PO_4 \cdot 12MoO_3$	12.100	11.08280
	P_2O_5	0.45784	9.66072
CaS	$BaSO_4$	3.2361	10.51002
$CaSO_4$	$BaSO_4$	1.7148	10.23419
	Ca	0.29434	9.46885
	$CaCl_2$	0.81525	9.91129
	$CaCO_3$	0.73507	9.86633
	CaF_2	0.57347	9.75851
	CaO	0.41187	9.61476
	$Ca_3(PO_4)_2$	0.75970	9.88064
	SO_3	0.58813	9.76947
$CaSO_4 \cdot 2H_2O$	$BaSO_4$	1.3558	10.13221
	$CaCO_3$	0.58123	9.76435
	CaO	0.32567	9.51278
	SO_3	0.46504	9.66749
$CaWO_4$	WO_3	0.80536	9.90599
Cl	Ca	0.56505	9.75209
	$CaCl_2$	1.5651	10.19453
	CaO	0.79068	9.89800
CO_2	CaO	1.2743	10.10528
	$CaCO_3$	2.2743	10.35685
HCl	$CaCO_3$	1.3721	10.13739
$Mg_2As_2O_7$	$Ca_3(AsO_4)_2$	1.2821	10.10793
MgO	CaO	1.3906	10.14321
$Mg_2P_2O_7$	$Ca_3(PO_4)_2$	1.3932	10.14402
$(NH_4)_3PO_4 \cdot 12MoO_3$	$Ca_3(PO_4)_2$	0.082642	8.91720
	$Ca(NO_3)_2$	1.5191	10.18158
P_2O_5	$Ca_3(PO_4)_2$	2.1842	10.33928
SO_3	CaO	0.70031	9.84529
	$CaSO_4$	1.7003	10.23052
	$CaSO_4 \cdot 2H_2O$	2.1504	10.33251
WO_3	$CaWO_4$	1.2418	10.09404
Carbon: C = 12.000			
Ag	CN	0.24108	9.38216
	HCN	0.25043	9.39868
	KCN	0.60349	9.78067
AgCN	CN	0.19425	9.28836
	HCN	0.20178	9.30488

GRAVIMETRIC FACTORS AND THEIR LOGARITHMS
(Continued)

Weighed	Sought	Factor	Logarithm
Carbon:			−10
AgCN	KCN	0.48627	9.68687
AgCNS	CNS	0.34993	9.54398
$BaCO_3$	C	0.060800	8.78390
	CO_2	0.22293	9.34817
	CO_3	0.30400	9.48287
BaO	CO_2	0.28689	9.45771
	CO_2, bicarbonate	0.57378	9.75874
$BaSO_4$	CNS	0.24877	9.39580
C	$BaCO_3$	16.447	11.21610
	CO_2	3.6667	10.56427
$CaCO_3$	CO_2	0.43969	9.64315
$Ca(HCO_3)_2$	CO_2	0.54293	9.73474
CN	AgCN	5.1480	10.71164
	Ag	4.1480	10.61784
CNS	AgCNS	2.8577	10.45602
	CuCNS	2.0947	10.32112
	$BaSO_4$	4.0197	10.60419
CaO	CO_2	0.78473	9.89472
	CO_2, bicarbonate	1.5695	10.19575
CO_2	$BaCO_3$	4.4857	10.65183
	$Ba(HCO_3)_2$	2.9476	10.46947
	BaO	3.4857	10.54229
	C	0.27273	9.43573
	$CaCO_3$	2.2743	10.35685
	$Ca(HCO_3)_2$	1.8419	10.26526
	CaO	1.2743	10.10528
	CO_3	1.3636	10.13470
	Cs_2CO_3	7.4009	10.86928
	$CsHCO_3$	4.4050	10.64395
	$FeCO_3$	2.6328	10.42041
	$Fe(HCO_3)_2$	2.0211	10.30559
	K_2CO_3	3.1407	10.49703
	$KHCO_3$	2.2751	10.35700
	K_2O	2.1407	10.33056
	Li_2CO_3	1.6791	10.22508
	$LiHCO_3$	1.5443	10.18873
	Li_2O	0.67910	9.83193
	$MgCO_3$	1.9164	10.28248
	$Mg(HCO_3)_2$	1.6629	10.22087
	MgO	0.91636	9.96207
	$MnCO_3$	2.6121	10.41698
	$Mn(HCO_3)_2$	2.0108	10.30336
	MnO	1.6120	10.20738
	Na_2CO_3	2.4090	10.38184
	$NaHCO_3$	1.9091	10.28083
	Na_2O	1.4090	10.14890
	$(NH_4)_2CO_3$	2.1837	10.33918
	NH_4HCO_3	1.7965	10.25444
	$PbCO_3$	6.0729	10.78339
	Rb_2CO_3	5.2473	10.71994
	$RbHCO_3$	3.3284	10.52224
	Rb_2O	4.2473	10.62811
	$SrCO_3$	3.3553	10.52573
Carbon:			−10
CO_2	$Sr(HCO_3)_2$	2.3824	10.37701
	SrO	2.3553	10.37204
CO_3	$BaCO_3$	3.2895	10.51713
	CO_2	0.73333	9.86530
	Cs_2CO_3	0.13513	9.13075
	$CsHCO_3$	0.22702	9.35606
	CuCNS	0.47740	9.67888
	$FeCO_3$	0.37983	9.57959
	$Fe(HCO_3)_2$	0.49478	9.69441
HCN	Ag	3.9932	10.60132
	AgCN	4.9559	10.69512
KCN	Ag	1.6570	10.21933
	AgCN	2.0565	10.31313
K_2CO_3	CO_2	0.31840	9.50297
KHCO3	CO_2	0.43954	9.64300
K_2O	CO_2	0.46713	9.66944
Li_2CO_3	CO_2	0.59556	9.77492
$LiHCO_3$	CO_2	0.64754	9.81127
Li_2O	CO_2	1.4726	10.16807
$MgCO_3$	CO_2	0.52182	9.71752
$Mg(HCO_3)_2$	CO_2	0.60136	9.77913
MgO	CO_2	1.0913	10.03794
$MnCO_3$	CO_2	0.38284	9.58302
$Mn(HCO_3)_2$	CO_2	0.49733	9.69664
MnO	CO_2	0.62033	9.79262
Na_2CO_3	CO_2	0.41511	9.61816
$NaHCO_3$	CO_2	0.52380	9.71917
Na_2O	CO_2	0.70974	9.85110
$(NH_4)_2CO_3$	CO_2	0.45795	9.66082
NH_4HCO_3	CO_2	0.55663	9.74556
$PbCO_3$	CO_2	0.16467	9.21661
Rb_2CO_3	CO_2	0.19058	9.28008
$RbHCO_3$	CO_2	0.30045	9.47777
Rb_2O	CO_2	0.23545	9.37190
$SrCO_3$	CO_2	0.29804	9.47427
$Sr(HCO_3)_2$	CO_2	0.41975	9.62299
SrO	CO_2	0.42458	9.62796
Cerium: Ce = 140.25			
Ce	$Ce_2(C_2O_4)_3 \cdot 3H_2O$	2.1339	10.32917
	$Ce(NO_3)_4$	2.7685	10.44224
	$Ce(NO_3)_4 \cdot (NH_4NO_3)_2$	4.0385	10.60622
	H_2O	1.2282	10.08927
	CeO_2	1.1711	10.06859
	Ce_2O_3	2.0274	10.30694
	$Ce_2(SO_4)_3$		

GRAVIMETRIC FACTORS AND THEIR LOGARITHMS
(Continued)

Weighed	Sought	Factor	Logarithm
Cerium:			−10
$Ce_2(C_2O_4)_3 \cdot 3H_2O$	$Ce_2(SO_4)_3$	0.95012	9.97778
	Ce	0.46863	9.67083
$Ce(NO_3)_4$	Ce	0.36121	9.55776
	Ce_2O_3	0.42302	9.62636
	CeO_2	0.44362	9.64701
$Ce(NO_3)_4 \cdot (NH_4NO_3)_2 \cdot H_2O$	Ce	0.24762	9.39379
	Ce_2O_3	0.28999	9.46238
	CeO_2	0.30412	9.48305
CeO_2	Ce	0.81422	9.91074
	$Ce(NO_3)_4$	2.2542	10.35299
	$Ce(NO_3)_4 \cdot (NH_4NO_3)_2 \cdot H_2O$	3.2882	10.51696
	Ce_2O_3	0.95356	10.97935
Ce_2O_3	Ce	0.85388	9.93140
	$Ce(NO_3)_4$	2.3640	10.37365
	$Ce(NO_3)_4 \cdot (NH_4NO_3)_2 \cdot H_2O$	3.4484	10.53762
	CeO_2	1.0487	10.02065
	$Ce_2(SO_4)_3$	1.7312	10.23835
$Ce_2(SO_4)_3$	Ce	0.49324	9.69306
	Ce_2O_3	0.57764	9.76166
	$Ce_2(C_2O_4)_3 \cdot 3H_2O$	1.0525	10.02222
Chlorine: Cl = 35.457			
Ag	Cl	0.32867	9.51676
	HCl	0.33802	9.52894
AgCl	Cl	0.24737	9.39334
	ClO_3	0.58224	9.76510
	ClO_4	0.69387	9.84128
	HCl	0.25440	9.40552
$BaCrO_4$	Cl	0.27987	9.44695
Ca	Cl	1.7698	10.24791
Cl	Ag	3.0426	10.48324
	AgCl	4.0426	10.60666
	$BaCrO_4$	3.5732	10.55305
	Ca	0.56505	9.75209
	HCl	1.0284	10.01218
	K	1.1027	10.04244
	KCl	2.1027	10.32277
	Li	0.19573	9.29166
	Mg	0.34295	9.53523
	$MgCl_2$	1.3429	10.12806
	MnO_2	1.2259	10.08844
	Na	0.64859	9.81197
	NaCl	1.6486	10.21711
	NH_4	0.50879	9.70654
	$PbCrO_4$	4.5578	10.65875
Chlorine:			−10
ClO_3	AgCl	1.7175	10.23490
	KCl	0.89331	9.95100
	NaCl	0.70041	9.84535
ClO_4	AgCl	1.4412	10.15872
	KCl	0.74960	9.87483
	NaCl	0.58773	9.76918
HCl	Ag	2.9584	10.47106
	AgCl	3.9308	10.59448
	NH_4Cl	1.4671	10.16645
	$(NH_4)_2SO_4$	1.8119	10.25814
	K	0.90690	9.95756
KCl	Cl	0.47559	9.67723
	ClO_3	1.1194	10.04899
	ClO_4	1.3340	10.12516
Li	Cl	5.1090	10.70834
Mg	Cl	2.9159	10.46477
$MgCl_2$	Cl	0.74463	9.87194
MnO_2	Cl	0.81576	9.91156
Na	Cl	1.5418	10.18803
NaCl	Cl	0.60659	9.78289
	ClO_3	1.4277	10.15464
	ClO_4	1.7015	10.23083
NH_4	Cl	1.9655	10.29346
NH_4Cl	HCl	0.68163	9.83355
$(NH_4)_2SO_4$	HCl	0.55190	9.74186
$PbCrO_4$	Cl	0.21941	9.34125
Chromium Cr = 52.01			
$BaCrO_4$	Cr	0.20526	9.31231
	Cr_2O_3	0.29998	9.47709
	CrO_3	0.39469	9.59626
	CrO_4	0.45784	9.66072
	$Cr_2(SO_4)_3 \cdot 18H_2O$	1.4139	10.15041
Cr	$BaCrO_4$	4.8718	10.68769
	Cr_2O_3	1.4614	10.16478
	$PbCrO_4$	6.2143	10.79339
Cr_2O_3	$BaCrO_4$	3.3335	10.52291
	Cr	0.68426	9.83522
	CrO_2	1.3157	10.11917
	CrO_4	1.5263	10.18362
	$PbCrO_4$	4.2522	10.62861
CrO_3	$BaCrO_4$	2.5336	10.40374
	Cr_2O_3	0.76003	9.88083
	K_2CrO_4	1.9418	10.28821
	$K_2Cr_2O_7$	1.4709	10.16759
	$PbCrO_4$	3.2318	10.50944
CrO_4	$BaCrO_4$	2.1842	10.33928
	$PbCrO_4$	2.7860	10.44498
$Cr_2(SO_4)_3 \cdot 18H_2O$	$BaCrO_4$	0.70728	9.84959
	$PbCrO_4$	0.90218	9.95529
K_2CrO_4	CrO_3	0.51498	9.71179
	$PbCrO_4$	1.6643	10.22122

GRAVIMETRIC FACTORS AND THEIR LOGARITHMS
(Continued)

Weighed	Sought	Factor	Logarithm
Chromium			−10
$K_2Cr_2O_7$	CrO_3	0.67984	9.83241
	$PbCrO_4$	2.1971	10.34185
$PbCrO_4$	Cr	0.16092	9.20661
	Cr_2O_3	0.23517	9.37139
	CrO_3	0.30943	9.49056
	CrO_4	0.35894	9.55502
	$Cr_2(SO_4)_3 \cdot 18H_2O$	1.1084	10.04471
	K_2CrO_4	0.60086	9.77877
	$K_2Cr_2O_7$	0.45514	9.65815
Cobalt: Co = 58.94			
Co	$Co(NO_3)_2 \cdot 6H_2O$	4.9381	10.69356
	$Co(NO_2)_3 \cdot (KNO_2)_3$	7.6736	10.88500
	CoO	1.2714	10.10430
	Co_3O_4	1.3620	10.13417
	$CoSO_4$	2.6298	10.41993
	$CoSO_4 \cdot 7H_2O$	4.7696	10.67848
	$(CoSO_4)_2 \cdot (K_2SO_4)_3$	7.0647	10.84909
$Co(NO_3)_2 \cdot 6H_2O$	Co	0.20250	9.30644
$Co(NO_2)_3 \cdot (KNO_2)_3$	Co	0.13032	9.11500
	CoO	0.16569	9.21930
CoO	Co	0.78650	9.89570
	$Co(NO_2)_2 \cdot (KNO_2)_3$	6.0353	10.78070
	Co_3O_4	1.0712	10.02987
	$CoSO_4$	2.0684	10.31563
	$(CoSO_4)_2 \cdot (K_2SO_4)_3$	5.5564	10.74479
Co_3O_4	Co	0.73423	9.86583
	CoO	0.93354	9.97013
$CoSO_4$	Co	0.38025	9.58007
	CoO	0.48347	9.68437
$CoSO_4 \cdot 7H_2O$	Co	0.20966	9.32152
	CoO	0.26658	9.42582
$(CoSO_4)_2 \cdot (K_2SO_4)_3$	Co	0.14155	9.15091
	CoO	0.17998	9.25521
Columbium: (niobium) Cb = 93.1			
Cb_2O_5	Cb	0.69947	9.84477
Cb	Cb_2O_5	1.4296	10.15521
Copper Cu = 63.57			−10
Cu	$Cu_2C_2H_3O_2(AsO_2)_3$	3.9880	10.60076
	CuCNS	1.9135	10.28183
	CuO	1.2517	10.09750
	Cu_2O	1.1258	10.05147
	Cu_2S	1.2522	10.09767
	$CuSO_4 \cdot 5H_2O$	3.9282	10.59419
$Cu_2C_2H_3O_2(As O_2)_3$	Cu	0.25075	9.39924
	$Mg_2As_2O_7$	0.91874	9.96319
CuCNS	Cu	0.52260	9.71817
	CuO	0.65414	9.81567
CuO	Cu	0.79891	9.90250
	CuCNS	1.5287	10.18433
	Cu_2S	1.0004	10.00017
	$CuSO_4 \cdot 5H_2O$	3.1383	10.49669
Cu_2O	Cu	0.88824	9.94853
	Cu_2S	1.1122	10.04619
$CuSO_4 \cdot 5H_2O$	Cu	0.25457	9.40581
	CuO	0.31865	9.50331
	Cu_2S	0.31877	9.50348
Cu_2S	Cu	0.79860	9.90233
	CuO	0.99960	9.99983
	Cu_2O	0.89910	9.95381
	$CuSO_4 \cdot 5H_2O$	3.1370	10.49651
$Mg_2As_2O_7$	$Cu_2C_2H_3O_2(AsO_2)_3$	1.0885	10.08681
Erbium: Er = 167.7			
Er	Er_2O_3	0.87480	9.94191
Er_2O_3	Er	1.1431	10.05808
Fluorine: F = 19.00			
BaF_2	$BaSiF_6$	1.5934	10.20232
$BaSiF_6$	BaF_2	0.62760	9.79768
	F	0.40796	9.61062
	HF	0.42962	9.63308
	H_2SiF_6	0.51560	9.71231
	SiF_4	0.37239	9.57100
	SiF_6	0.50838	9.70619
CaF_2	F	0.48675	9.68730
	HF	0.51258	9.70976
	H_2SiF_6	0.61516	9.78899
	SiF_6	0.60655	9.78287
$CaSO_4$	F	0.29395	9.44581
	HF	0.27913	9.46827
F	$BaSiF_6$	2.4512	10.38938
	CaF_2	2.05447	10.31270
	$CaSO_4$	3.5825	10.55419

GRAVIMETRIC FACTORS AND THEIR LOGARITHMS
(Continued)

Weighed	Sought	Factor	Logarithm
Fluorine:			−10
$CaSO_4$...	H_2SiF_6.....	1.2638	10.10169
	$K2SiF_6$.....	1.9320	10.28602
HF.....	$BaSiF_6$.....	2.8277	10.36692
	CaF_2.....	1.9509	10.29024
	$CaSO_4$.....	3.4020	10.53173
	K_2SiF_6.....	1.8347	10.26356
2HF....	H_2SiF_6.....	3.6004	10.55635
6HF....	H_2SiF_6.....	1.2001	10.07923
H_2SiF_6..	$BaSiF_6$.....	1.9395	10.28769
	CaF_2.....	1.6256	10.21101
	F.....	0.79124	9.89831
	2HF.....	0.27775	9.44365
	6HF.....	0.83324	9.92077
	K_2SiF_6.....	1.5287	10.18432
	SiF_4.....	0.72225	9.85869
	SiF_6.....	0.98600	9.99388
KF.....	K_2SiF_6.....	1.8956	10.27774
K_2SiF_6..	F.....	0.51759	9.71398
	HF.....	0.54505	9.73644
	H_2SiF_6.....	0.65414	9.81567
	KF.....	0.52755	9.72226
	SiF_6.....	0.64499	9.80955
SiF_4.....	$BaSiF_6$.....	2.6854	10.42900
	H_2SiF_6.....	1.3845	10.14131
SiF_6.....	$BaSiF_6$.....	1.9670	10.29381
	CaF_2.....	1.6487	10.21714
	H_2SiF_6.....	1.0142	10.00612
	K_2SiF_6.....	1.5504	10.19045
Gallium: Ga = 69.72			
Ga_2O_3...	Ga.....	0.74392	9.87153
Ga_2S_3....	Ga.....	0.59177	9.77215
Ga.....	Ga_2O_3.....	1.3442	10.12846
	Ga_2S_3.....	1.6898	10.22784
Germanium: Ge = 72.60			
GeO_2....	Ge.....	0.69407	9.84140
K_2GeF_6..	Ge.....	0.27418	9.43804
Ge.....	GeO_2.....	1.4408	10.15860
	K_2GeF_6....	3.6473	9.56197
Gold: Au = 197.2			
Au.....	$AuCl_3$.....	1.5394	10.18735
	$HAuCl_4$· $4H_2O$....	2.0897	10.32009
	$KAu(CN)_4$· H_2O.....	1.8172	10.25939
$AuCl_3$...	Au.....	0.64960	9.81265
$HAuCl_4$· $4H_2O$..	Au.....	0.47853	9.67991
$KAu(CN)_4$· H_2O...	Au.....	0.55031	9.74061

Weighed	Sought	Factor	Logarithm
Hydrogen: H = 1.008			−10
H.....	O.....	7.9365.	10.89963
	H_2O.....	8.9365	10.95117
H_2O.....	H.....	0.11190	9.04884
O.....	H.....	0.12595	9.10020
HCNS...	AgCNS....	2.8089	10.44854
	CuCNS....	2.0589	10.31364
	$BaSO_4$.....	3.9512	10.59673
AgCNS..	HCNS.....	0.35601	9.55146
CuCNS..	HCNS.....	0.48569	9.68636
$BaSO_4$...	HCNS.....	0.25309	9.40328
Indium: In = 114.8			
In.....	In_2O_3.....	1.2091..	10.08246
	In_2S_3.....	1.4190	10.15198
In_2O_3....	In.....	0.82709	9.91755
In_2S_3....	In.....	0.70474	9.84803
Iodine: I = 126.932			
Ag.....	HI.....	1.1860	10.07407
	I.....	1.1766	10.07063
AgCl....	I.....	0.88555	9.94721
AgI.....	HI.....	0.54486	9.73629
	I.....	0.54056	9.73285
	IO_3.....	0.74498	9.87215
	IO_4.....	0.81313	9.91016
	I_2O_5.....	0.71092	9.85182
	I_2O_7.....	0.77906	9.89157
HI.....	Ag.....	0.84320	9.92593
	AgI.....	1.8353	10.26371
	Pd.....	0.41698	9.62012
	PdI_2.....	1.4091	10.14895
	TlI.....	2.5896	10.41324
I.....	Ag.....	0.84990	9.92937
	AgCl.....	1.1292	10.05277
	AgI.....	1.8499	10.26715
	Pd.....	0.42040	9.62366
	PdI_2.....	1.4203	10.15239
	TlI.....	2.6102	10.41668
IO_3.....	AgI.....	1.3423	10.12785
	PdI_2.....	1.0306	10.01309
	TlI.....	1.8940	10.27737
IO_4.....	AgI.....	1.2298	10.08984
	PdI_2.....	0.94424	9.97508
	TlI.....	1.7353	10.23937
I_2O_5.....	AgI.....	1.4066	10.14818
	PdI_2.....	1.0800	10.03342
	TlI.....	1.9848	10.29771
I_2O_7.....	AgI.....	1.2836	10.10843
	PdI_2.....	0.98553	9.99367
	TlI.....	1.8112	10.25796
Pd.....	HI.....	2.3982	10.37988
	I.....	2.3793	10.37644
PdI_2....	HI.....	0.70967	9.85105

GRAVIMETRIC FACTORS AND THEIR LOGARITHMS
(Continued)

Weighed	Sought	Factor	Logarithm
Iodine:			−10
PdI_2	I	0.70407	9.84761
	IO_3	0.97030	9.98691
	IO_4	1.0590	10.02492
	I_2O_5	0.92594	9.96658
	I_2O_7	1.0147	10.00633
TlI	HI	0.38615	9.58676
	I	0.38311	9.58332
	IO_3	0.52799	9.72262
	IO_4	0.57628	9.76063
	I_2O_5	0.50381	9.70229
	I_2O_7	0.55213	9.74204
Iron: Fe = 55.84			
Ag	$Fe_7(CN)_{18}$, prussian blue	0.44237	9.64579
CN	$Fe_7(CN)_{18}$	1.8341	10.26362
CO_2	FeO	1.6327	10.21292
	$FeCO_3$	2.6328	10.42041
	$Fe(HCO_3)_2$	2.0211	10.30559
Fe	$Fe(HCO_3)_2$	3.1851	10.50312
	FeO	1.2865	10.10943
	Fe_2O_3	1.4298	10.15527
	$FePO_4$	2.7017	10.43164
	FeS	1.5742	10.19706
	$FeSO_4$	2.7203	10.43462
	$FeSO_4 \cdot 7H_2O$	4.9788	10.69712
	$FeSO_4 \cdot (NH_4)_2 \cdot SO_4 \cdot 6H_2O$	7.0227	10.84650
$FeAsO_4$	$Mg_2As_2O_7$	0.79714	9.90162
$FeCl_3$	Fe_2O_3	0.49220	9.69214
$Fe_7(CN)_{18}$, prussian blue	Ag	2.2605	10.35421
	CN	0.54498	9.73638
$FeCO_3$	CO_2	0.37983	9.57959
	FeO	0.62017	9.79251
	Fe_2O_3	0.68922	9.83836
$Fe(HCO_3)_2$	CO_2	0.49478	9.69441
	Fe	0.31396	9.49688
	FeO	0.40393	9.60630
	Fe_2O_3	0.44890	9.65215
FeO	CO_2	0.61246	9.78708
	Fe	0.77728	9.89058
	$FeCO_3$	1.6125	10.20749
	$Fe(HCO_3)_2$	2.4757	10.39370
	Fe_2O_3	1.1114	10.04585
	$FePO_4$	2.1000	10.32222
	FeS	1.2236	10.08764
	SO_3	1.1145	10.04707
Fe_3O_4	Fe_2O_3	1.0346	10.01477
Iron:			−10
Fe_2O_3	Fe	0.69940	9.84473
	$FeCl_3$	2.0317	10.30786
	$FeCO_3$	1.4509	10.16164
	$Fe(HCO_3)_2$	2.2277	10.34785
	$Fe(HCO_3)_3$	2.9918	10.47593
	FeO	0.89980	9.95415
	Fe_3O_4	0.96657	9.98523
	$FePO_4$	1.8896	10.27637
	FeS	1.1010	10.04179
	$FeSO_4$	1.9026	10.27935
	$FeSO_4 \cdot 7H_2O$	3.4822	10.54185
	$FeSO_4 \cdot (NH_4)_2 \cdot SO_4 \cdot 6H_2O$	4.9117	10.69123
	$Fe_2(SO_4)_3$	2.5042	10.39867
$FePO_4$	Fe	0.37013	9.56836
	FeO	0.47619	9.67778
	Fe_2O_3	0.52921	9.72363
FeS	Fe	0.63524	9.80294
	FeO	0.81726	9.91236
	Fe_2O_3	0.90826	9.95821
$FeSO_4$	Fe	0.36760	9.56538
	Fe_2O_3	0.52559	9.72065
	SO_3	0.52708	9.72187
$FeSO_4 \cdot 7H_2O$	Fe	0.20085	9.30288
	Fe_2O_3	0.28718	9.45815
$FeSO_4 \cdot (NH_4)_2 \cdot SO_4 \cdot 6H_2O$	Fe	0.14240	9.15350
	Fe_2O_3	0.20360	9.30877
$Fe_2(SO_4)_3$	Fe_2O_3	0.39933	9.60133
$Mg_2As_2O_7$	$FeAsO_4$	1.2542	10.09838
SO_3	FeO	0.89728	9.95293
	$FeSO_4$	1.8973	10.27813
Lanthanum: La = 138.90			
La	La_2O_3	1.1728	10.06922
La_2O_3	La	0.85267	9.93078
Lead: Pb = 207.20			
$BaSO_4$	$PbSO_4$	1.2992	10.11366
Pb	$PbCl_2$	1.3422	10.12783
	$PbCO_3$	1.2896	10.11045
	$(PbCO_3)_2 \cdot Pb(OH)_2$	1.2478	10.09614
	$PbCrO_4$	1.5599	10.19309
	$Pb(OH)_2$	1.1641	10.06599
	PbO	1.0772	10.03230
	PbO_2	1.1544	10.06236
	PbS	1.1548	10.06249
	$PbSO_4$	1.4636	10.16543

GRAVIMETRIC FACTORS AND THEIR LOGARITHMS
(Continued)

Weighed	Sought	Factor	Logarithm
Lead:			−10
$PbCl_2$	Pb	0.74502	9.87217
	PbO	0.80254	9.90447
$Pb(C_2H_3O_2)_2 \cdot 3H_2O$	$PbCrO_4$	0.85212	9.93050
	$PbSO_4$	0.79954	9.90284
$PbCO_3$	Pb	0.77544	9.88955
	PbO	0.83532	9.92185
	$PbSO_4$	1.1349	10.05498
$(PbCO_3)_2 \cdot Pb(OH)_2$	Pb	0.80142	9.90386
	$PbCrO_4$	1.2501	10.09695
	$PbSO_4$	1.1730	10.06929
$PbCrO_4$	Pb	0.64107	9.80691
	$Pb(C_2H_3O_2)_2 \cdot 3H_2O$	1.1735	10.06950
	$(PbCO_3)_2 \cdot Pb(OH)_2$	0.79992	9.90305
	PbO	0.69057	9.83921
	Pb_3O_4	0.70708	9.84947
	$PbSO_4$	0.93830	9.97234
$Pb(NO_3)_2$	PbO	0.67387	9.82858
	PbO_2	0.72218	9.85865
	$PbSO_4$	0.91560	9.96171
PbO	Pb	0.92832	9.96770
	$PbCl_2$	1.2460	10.09553
	$PbCO_3$	1.1972	10.07815
	$PbCrO_4$	1.4481	10.16079
	$Pb(NO_3)_2$	1.4840	10.17143
	PbO_2	1.0717	10.03007
	PbS	1.0720	10.03019
	$PbSO_4$	1.3587	10.13313
PbO_2	Pb	0.86622	9.93763
	$Pb(NO_3)_2$	1.3847	10.14136
	PbO	0.93311	9.96993
	$PbSO_4$	1.2678	10.10306
Pb_3O_4	$PbCrO_4$	1.4143	10.15053
	$PbSO_4$	1.3270	10.12287
$Pb(OH)_2$	Pb	0.85838	9.93398
PbS	Pb	0.86598	9.93751
	PbO	0.93284	9.96981
	$PbSO_4$	1.2675	10.10294
$PbSO_4$	$BaSO_4$	0.76973	9.88634
	Pb	0.68323	9.83457
	$Pb(C_2H_3O_2)_2 \cdot 3H_2O$	1.2507	10.09716
	$PbCO_3$	0.88108	9.94502
	$(PbCO_3)_2 \cdot Pb(OH)_2$	0.85253	9.93071
	$PbCrO_4$	1.0658	10.02766
	$Pb(NO_3)_2$	1.0922	10.03829
	PbO	0.73598	9.86687
	PbO_2	0.78875	9.89694
	Pb_3O_4	0.75358	9.87713
	PbS	0.78897	9.89706

Weighed	Sought	Factor	Logarithm
Lithium: Li = 6.940			−10
CO_2	Li_2CO_3	1.6791	10.22508
	$LiHCO_3$	1.5443	10.18873
	Li_2O	0.67910	9.83193
Li	LiCl	6.1091	10.78598
	Li_2CO_3	5.3228	10.72614
	Li_2O	2.1539	10.33322
	Li_3PO_4	5.5641	10.74540
	Li_2SO_4	7.9210	10.89878
LiCl	Li	0.16369	9.21402
	Li_2CO_3	0.87128	9.94016
	Li_2O	0.35238	9.54701
	Li_3PO_4	0.91080	9.95942
	Li_2SO_4	1.2966	10.11280
Li_2CO_3	CO_2	0.59556	9.77492
	Li	0.18787	9.27386
	LiCl	1.1477	10.05984
	$LiHCO_3$	1.8394	10.26468
	Li_2O	0.40444	9.60685
	Li_3PO_4	1.0453	10.01926
$LiHCO_3$	CO_2	0.64754	9.81127
	Li_2CO_3	0.54365	9.73532
	Li_2O	0.21987	9.34217
	Li_3PO_4	0.56831	9.75459
Li_2O	CO_2	1.4726	10.16807
	Li	0.46452	9.66700
	LiCl	2.8379	10.45299
	Li_2CO_3	2.4726	10.39315
	$LiHCO_3$	4.5481	10.65783
	Li_3PO_4	2.5847	10.41241
	Li_2SO_4	3.6795	10.56579
	SO_3	2.6796	10.42806
Li_3PO_4	Li	0.17972	9.25460
	LiCl	1.0979	10.04058
	Li_2CO_3	0.95662	9.98074
	$LiHCO_3$	1.7596	10.24542
	Li_2O	0.38689	9.58759
	Li_2SO_4	1.4236	10.15338
	$Li_2SO_4 \cdot H_2O$	1.6568	10.21928
Li_2SO_4	Li	0.12625	9.10122
	LiCl	0.77126	9.88720
	Li_2O	0.27178	9.43421
	Li_3PO_4	0.70246	9.84662
	SO_3	0.72823	9.86227
$Li_2SO_4 \cdot H_2O$	Li_2PO_4	0.60356	9.78072
SO_3	Li_2O	0.37320	9.57194
	Li_2SO_4	1.3732	10.13773
Magnesium: Mg = 24.32			
$BaSO_4$	$MgSO_4$	0.51571	9.71241
	$MgSO_4 \cdot 7H_2O$	1.0560	10.02365
Br	Mg	0.15216	9.18229

GRAVIMETRIC FACTORS AND THEIR LOGARITHMS
(Continued)

Weighed	Sought	Factor	Logarithm
Magnesium:			−10
Br	$MgBr_2$	1.1521	10.06150
	$MgBr_2 \cdot 6H_2O$	1.8284	10.26208
Cl	Mg	0.34295	9.53523
	$MgCl_2$	1.3429	10.12806
	$MgCl_2 \cdot 6H_2O$	2.8673	10.45747
CO_2	$MgCO_3$	1.9164	10.28248
	MgO	0.91636	9.96207
I	Mg	0.095798	8.98136
	MgI_2	1.0958	10.03973
Mg	Br	6.5722	10.81771
	Cl	2.9159	10.46477
	I	1.0439	10.01864
	$MgCO_3$	3.4671	10.53997
	MgO	1.6579	10.21956
	$Mg_2P_2O_7$	4.5784	10.66072
	$MgSO_4$	4.9500	10.69461
$MgBr_2$	Br	0.86796	9.93850
$MgBr_2 \cdot 6H_2O$	Br	0.54691	9.73792
$MgCl_2$	Cl	0.74463	9.87194
	$Mg_2P_2O_7$	1.1692	10.06789
$MgCl_2 \cdot 6H_2O$	Cl	0.34876	9.54253
	$Mg_2P_2O_7$	0.54763	9.73848
$MgCl_2 \cdot KCl \cdot 6H_2O$	$Mg_2P_2O_7$	0.40070	9.60282
$MgCO_3$	CO_2	0.52182	9.71752
	Mg	0.28843	9.46004
	$Mg(HCO_3)_2$	1.7355	10.23942
	MgO	0.47818	9.67959
	$Mg_2P_2O_7$	1.3205	10.12075
$Mg(HCO_3)_2$	$MgCO_3$	0.57621	9.76058
	MgO	0.27553	9.44017
	$Mg_2P_2O_7$	0.76090	9.88133
MgI_2	I	0.91258	9.96027
MgO	CO_2	1.0913	10.03793
	Mg	0.60317	9.78044
	$MgCO_3$	2.0913	10.32041
	$Mg(HCO_3)_2$	3.6293	10.55983
	$Mg_2P_2O_7$	2.7616	10.44116
	$MgSO_4$	2.9857	10.47505
	SO_3	1.9857	10.29791
$Mg_2P_2O_7$	Mg	0.21842	9.33928
	$MgCl_2$	0.85528	9.93211
	$MgCl_2 \cdot 6H_2O$	1.8261	10.26152
	$MgCl_2 \cdot KCl \cdot 6H_2O$	2.4956	10.39718
	$MgCO_3$	0.75727	9.87925
	$Mg(HCO_3)_2$	1.3142	10.11867
	MgO	0.36211	9.55884
	$MgSO_4$	1.0812	10.03389
	$MgSO_4 \cdot 7H_2O$	2.2138	10.34513
$MgSO_4$	$BaSO_4$	1.9390	10.28759
Magnesium:			−10
$MgSO_4$	Mg	0.20202	9.30539
	MgO	0.33493	9.52495
	$Mg_2P_2O_7$	0.92494	9.96611
	SO_3	0.66507	9.82287
$MgSO_4 \cdot 7H_2O$	$BaSO_4$	0.94700	9.97635
	$Mg_2P_2O_7$	0.45172	9.65487
	SO_3	0.32481	9.51163
SO_3	MgO	0.50359	9.70208
	$MgSO_4$	1.5036	10.17713
	$MgSO_4 \cdot 7H_2O$	3.0787	10.48837
Manganese: Mn = 54.93			
$BaSO_4$	$MnSO_4$	0.64684	9.81080
CO_2	$MnCO_3$	2.6121	10.41698
	MnO	1.6120	10.20738
Mn	$MnCO_3$	2.0923	10.32062
	MnO	1.2913	10.11102
	Mn_2O_3	1.4369	10.15744
	Mn_3O_4	1.3884	10.14251
	$Mn_2P_2O_7$	2.5843	10.41234
$MnCO_3$	CO_2	0.38284	9.58302
	Mn	0.47794	9.67938
	MnS	1.5837	10.19967
	$MnSO_4$	2.7488	10.43914
	$Mn(HCO_3)_2$	1.5396	10.18741
	MnO	0.61716	9.79040
	Mn_3O_4	0.66357	9.82189
	$Mn_2P_2O_7$	1.2352	10.09173
	MnS	0.75693	9.87906
$Mn(HCO_3)_2$	$MnCO_3$	0.64951	9.81259
	MnO	0.40085	9.60299
	Mn_3O_4	0.43100	9.63448
MnO	CO_2	0.62033	9.79262
	Mn	0.77442	9.88898
	$MnCO_3$	1.6203	10.20960
	$Mn(HCO_3)_2$	2.4946	10.39701
	Mn_2O_3	1.1128	10.04641
	Mn_3O_4	1.0752	10.03149
	$Mn_2P_2O_7$	2.0014	10.30133
	MnS	1.2265	10.08866
	$MnSO_4$	2.1288	10.32813
	SO_3	1.1288	10.05261
Mn_2O_3	Mn	0.69593	9.84256
	MnO	0.89865	9.95359
	Mn_3O_4	0.96623	9.98508
Mn_3O_4	Mn	0.72026	9.85749
	$MnCO_3$	1.5070	10.17811
	$Mn(HCO_3)_2$	2.3202	10.36552
	MnO	0.93006	9.96851
	Mn_2O_3	1.0349	10.01491
	MnO_2	1.1398	10.05685

GRAVIMETRIC FACTORS AND THEIR LOGARITHMS
(Continued)

Weighed	Sought	Factor	Logarithm
Manganese:			−10
Mn_3O_4	$MnSO_4$	1.9799	10.29664
MnO_2	$Mn_2P_2O_7$	1.6330	10.21299
	Mn_3O_4	0.87730	9.94315
$Mn_2P_2O_7$	Mn	0.38695	9.58765
	$MnCO_3$	0.80960	9.90827
	MnO	0.49966	9.69867
	MnO_2	0.61236	9.78701
	$MnSO_4$	1.0637	10.02680
MnS	Mn	0.63143	9.80032
	$MnCO_3$	1.3211	10.12094
	MnO	0.81534	10.91134
	$MnSO_4$	1.7357	10.23947
$MnSO_4$	$BaSO_4$	1.5460	10.18920
	MnO	0.46975	9.67187
	Mn_3O_4	0.50508	9.70336
	$Mn_2P_2O_7$	0.94016	9.97320
	MnS	0.57614	9.76053
	Mn	0.36379	9.56086
	SO_3	0.53025	9.72448
SO_3	MnO	0.88592	9.94739
	$MnSO_4$	1.8859	10.27552
Mercury: Hg = 200.61			
Hg	HgCl	1.1768	10.07069
	$HgCl_2$	1.3535	10.13146
	HgO	1.0798	10.03333
	HgS	1.1598	10.06440
HgCl	Hg	0.84978	9.92931
	$HgCl_2$	1.1502	10.06077
	$HgNO_3$	1.1125	10.04628
	Hg_2O	0.88368	9.94629
	HgO	0.91758	9.96264
	HgS	0.98563	9.99371
$HgCl_2$	Hg	0.73882	9.86854
	HgCl	0.86942	9.93923
	HgS	0.85692	9.93294
$Hg(CN)_2$	HgS	0.92102	9.96427
$HgNO_3$	HgCl	0.89892	9.95372
	HgS	0.88600	9.94743
$Hg(NO_3)_2$	HgS	0.71675	9.85537
$Hg(NO_3)_2 \cdot H_2O$	HgS	0.67907	9.83191
Hg_2O	HgCl	1.1316	10.05371
	HgS	1.1154	10.04742
HgO	Hg	0.92613	9.96667
	HgCl	1.0898	10.03736
	HgS	1.0742	10.03107
HgS	HgCl	1.0146	10.00629
	$HgCl_2$	1.1670	10.06706
	$Hg(CN)_2$	1.0858	10.03573
	$HgNO_3$	1.1287	10.05257
	$Hg(NO_3)_2$	1.3952	10.14463
Mercury: HgS	$Hg(NO_3)_2 \cdot H_2O$	1.4726	10.16809
	Hg_2O	0.89656	9.95258
	HgO	0.93096	9.96893
	Hg	0.86220	9.93561
	$HgSO_4$	1.2751	10.10553
	HgS	0.78428	9.89447
$HgSo_4$			
Molybdenum: Mo = 96.0			
Mo	MoO_3	1.5000	10.17609
	MoS_3	2.0020	10.30146
	$PbMoO_4$	3.8239	10.58251
MoO_3	Mo	0.66667	9.82391
	MoS_3	1.3347	10.12537
	$(NH_4)_2MoO_4$	1.3617	10.13408
	$(NH_4)_3PO_4 \cdot 12MoO_3$	1.0863	10.03596
	$PbMoO_4$	2.5500	10.40654
MoS_3	Mo	0.49950	9.69854
	MoO_3	0.74925	9.87463
	$(NH_4)_2MoO_4$	1.0203	10.00871
$(NH_4)_2MoO_4$	MoO_3	0.73437	9.86592
	MoS_3	0.98015	9.99129
	$(NH_4)_3PO_4 \cdot 12MoO_3$	0.79778	9.90188
	$PbMoO_4$	1.8727	10.27247
$(NH_4)_3PO_4 \cdot 12MoO_3$	MoO_3	0.92054	9.96404
	$(NH_4)_2MoO_4$	1.2535	10.09812
$PbMoO_4$	Mo	0.26144	9.41737
	MoO_3	0.39216	9.59346
	$(NH_4)_2MoO_4$	0.53399	9.72753
Neodymium: Nd = 144.27			
Nd	Nd_2O_3	1.1664	10.06685
Nd_2O_3	Nd	0.85737	9.93317
Nickel: Ni = 58.69			
Ni	Ni-glyoxime	4.9214	10.69209
	$Ni(NO_3)_2 \cdot 6H_2O$	4.9549	10.69503
	NiO	1.2726	10.10470
	$NiSO_4$	2.6368	10.42108
	$NiSO_4 \cdot 7H_2O$	4.7857	10.67994

GRAVIMETRIC FACTORS AND THEIR LOGARITHMS
(Continued)

Weighed	Sought	Factor	Logarithm
Nickel:			−10
Ni-glyoxime	Ni	0.20320	9.30791
	NiO	0.25859	9.41261
$Ni(NO_3)_2 \cdot 6H_2O$	Ni	0.20182	9.30497
	NiO	0.25684	9.40967
	$NiSO_4$	0.53218	9.72605
NiO	Ni	0.78578	9.89530
	Ni-glyoxime	3.8671	10.58739
	$Ni(NO_3)_2 \cdot 6H_2O$	3.8934	10.59033
	$NiSO_4$	2.0720	10.31638
	$NiSO_4 \cdot 7H_2O$	3.7605	10.57524
$NiSO_4$	Ni	0.37925	9.57892
	$Ni(NO_3)_2 \cdot 6H_2O$	1.8791	10.27395
	NiO	0.48263	9.68362
	$NiSO_4 \cdot 7H_2O$	1.8149	10.25886
$NiSO_4 \cdot 7H_2O$	Ni	2.0896	9.32006
	NiO	0.26593	9.42476
	$NiSO_4$	0.55099	9.74114
Nitrogen: $N = 14.008$			
$AgNO_2$	HNO_2	0.30554	9.48507
	N_2O_3	0.24699	9.39269
HNO_2	$AgNO_2$	3.2729	10.51493
HNO_3	N	0.22231	9.34696
	NH_3	0.27023	9.43173
	NH_4Cl	0.84894	9.92888
	$(NH_4)_2PtCl_6$	5.3233	10.54695
	NO	0.47620	9.67779
	Pt	1.5491	10.19007
	SO_3	0.63527	9.80296
KNO_3	N_2O_5	0.53419	9.72769
N	HNO_3	4.4982	10.65304
	$NaNO_3$	6.0683	10.78307
	NH_3	1.2155	10.08477
	NH_4Cl	3.8190	10.58195
	$(NH_4)_2PtCl_6$	15.850	11.20002
	$(NH_4)_2SO_4$	4.7167	10.67364
	NO_2	3.2841	10.51641
	N_2O_3	2.7131	10.43346
	NO_3	4.4261	10.64602
	N_2O_5	3.8551	10.58603
	Pt	6.9685	10.84314
	SO_3	2.8578	10.45603
$NaNO_3$	N	0.16479	9.21693
	N_2O_5	0.63534	9.80301
NO	HNO_3	2.1000	10.32222
Nitrogen:			−10
NO	NO_2	1.5332	10.18566
	N_2O_3	1.2666	10.10264
	NO_3	2.0664	10.31521
	N_2O_5	1.7998	10.25525
N_2O_3	$AgNO_2$	4.0487	10.60735
	N	0.36858	9.56655
	NO	0.78953	9.89735
N_2O_5	KNO_3	1.8720	10.27235
	N	0.25940	9.41397
	$NaNO_3$	1.5740	10.19695
	NH_3	0.31531	9.49875
	NH_4Cl	0.99054	9.99585
	$(NH_4)_2PtCl_6$	4.1109	10.61395
	$(NH_4)_2SO_4$	1.2234	10.08756
	NO	0.55562	9.74478
	Pt	1.8074	10.25705
	SO_3	0.74122	9.86995
NO_2	N	0.30450	9.48355
	NO	0.65226	9.81443
NO_3	N	0.22593	9.35395
	NH_3	0.27467	9.43885
	NH_4Cl	0.86274	9.93585
	NO	0.48393	9.68475
	Pt	1.5742	10.19705
NH_3	HNO_3	3.7006	10.56825
	N	0.82268	9.91525
	N_2O_5	3.1710	10.50125
	NO_3	3.6407	10.56135
NH_4Cl	HNO_3	1.1779	10.07115
	NO_2	1.1591	10.06415
	N_2O_5	1.0096	10.00415
	N	0.26185	9.41805
$(NH_4)_2PtCl_6$	HNO_3	0.28383	9.45305
	N	0.063093	8.79995
	N_2O_5	0.24326	9.38605
	NO_3	0.27928	9.44605
$(NH_4)_2SO_4$	N	0.21201	9.32635
	N_2O_5	0.81742	9.91245
Pt	HNO_3	0.64555	9.80995
	N	0.14350	9.15685
	NO_3	0.63524	9.80295
	N_2O_5	0.55328	9.74295
SO_3	HNO_3	1.5741	10.19705
	N	0.34992	9.54395
	N_2O_5	1.3491	10.13005
Osmium: $Os = 190.8$			
Os	OsO_4	1.3354	10.12565
OsO_4	Os	0.74882	9.87435
Palladium: $Pd = 106.7$			
Pd	K_2PdCl_6	3.7267	10.57135

GRAVIMETRIC FACTORS AND THEIR LOGARITHMS
(Continued)

Weighed	Sought	Factor	Logarithm
			−10
Palladium:			
Pd	PdI_2	3.3792	10.52881
	$PdCl_2 \cdot 2H_2O$	2.0023	10.30153
	$Pd(NO_3)_2$	2.1623	10.33492
$PdCl_2 \cdot 2H_2O$	K_2PdCl_6	1.8612	10.26979
	Pd	0.49942	9.69847
$Pd(NO_3)_2$	Pd	0.46247	9.66508
PdI_2	Pd	0.29593	9.47119
K_2PdCl_6	Pd	0.26834	9.42869
	$PdCl_2 \cdot 2H_2O$	0.53729	9.73021
Phosphorus: P = 31.027			
Ag_3PO_4	P	0.074108	8.86987
	PO_4	0.22698	9.35598
	P_2O_5	0.16965	9.22955
$Ag_4P_2O_7$	P	0.10247	9.01060
	PO_4	0.31384	9.49671
	P_2O_5	0.23457	9.37028
Al_2O_3	P_2O_5	1.3935	10.14411
$AlPO_4$	PO_4	0.77893	9.89150
	P_2O_5	0.58220	9.76507
$Ca_3(PO_4)_2$	P_2O_5	0.45786	9.66073
$FePO_4$	PO_4	0.62989	9.79926
	P_2O_5	0.47079	9.67283
$Mg_2P_2O_7$	Na_2HPO_4	1.2756	10.10570
	$Na_2HPO_4 \cdot 12H_2O$	3.2172	10.50748
	$NaNH_4HPO_4 \cdot 4H_2O$	1.8782	10.27375
	P	0.27865	9.44506
	PO_4	0.85344	9.93117
	P_2O_5	0.63789	9.80474
Na_2HPO_4	$Mg_2P_2O_7$	0.78397	9.89430
	P_2O_5	0.50008	9.69904
$Na_2HPO_4 \cdot 12H_2O$	$Mg_2P_2O_7$	0.31083	9.49252
	P_2O_5	0.19827	9.29726
$NaNH_4HPO_4 \cdot 4H_2O$	$Mg_2P_2O_7$	0.53241	9.72625
	P_2O_5	0.33962	9.53099
$(NH_4)_3PO_4 \cdot 12MoO_3$	P	0.016529	8.21824
	PO_4	0.050623	8.70435
	P_2O_5	0.037837	8.57792
P	Ag_3PO_4	13.494	11.13013
	$Ag_4P_2O_7$	9.7588	10.98940
	$Mg_2P_2O_7$	3.5888	10.55494
	$(NH_4)_3PO_4 \cdot 12MoO_3$	60.500	11.78176
	P_2O_5	2.2892	10.35968
	$P_2O_5 \cdot 24MoO_3$	57.983	11.76330
Phosphorus:			
P	$U_2P_2O_{11}$	11.512	11.06117
PO_4	Ag_3PO_4	4.4058	10.64404
	$Ag_4P_2O_7$	3.1863	10.50329
	$AlPO_4$	1.2838	10.10850
	$FePO_4$	1.5876	10.20074
	$Mg_2P_2O_7$	1.1717	10.06883
	$(NH_4)_3PO_4 \cdot 12MoO_3$	19.754	11.29565
	$P_2O_5 \cdot 24MoO_3$	18.932	11.27720
	$U_2P_2O_{11}$	3.7589	10.57506
P_2O_5	Ag_3PO_4	5.8946	10.77045
	$Ag_4P_2O_7$	4.2630	10.62972
	Al_2O_3	0.71762	9.85589
	$AlPO_4$	1.7176	10.23493
	$Ca_3(PO_4)_2$	2.1841	10.33927
	$FePO_4$	2.1241	10.32717
	$Mg_2P_2O_7$	1.5677	10.19526
	Na_2HPO_4	1.9997	10.30096
	$Na_2HPO_4 \cdot 12H_2O$	5.0436	10.70274
	$NaNH_4H PO_4 \cdot 4H_2O$	2.9445	10.46901
	$(NH_4)_3PO_4 \cdot 12MoO_3$	26.429	11.42208
	P	0.43683	9.64031
	$P_2O_5 \cdot 24MoO_3$	25.329	11.40362
	$U_2P_2O_{11}$	5.0291	10.70149
$P_2O_5 \cdot 24MoO_3$	P	0.01725	8.23679
	PO_4	0.05282	8.72280
	P_2O_5	0.03948	8.59638
$U_2P_2O_{11}$	P	0.086862	8.93883
	PO_4	0.26604	9.42494
	P_2O_5	0.19884	9.29851
Platinum: Pt = 195.23			
$H_2PtCl_6 \cdot 6H_2O$	K_2PtCl_6	0.93838	9.97238
	Pt	0.37683	9.57615
K_2PtCl_6	$H_2PtCl_6 \cdot 6H_2O$	1.0657	10.02782
	Pt	0.40158	9.60377
	$PtCl_4$	0.69332	9.84093
	$PtCl_4 \cdot 5H_2O$	0.87860	9.94379
$(NH_4)_2 PtCl_6$	Pt	0.43966	9.64312
	$PtCl_4$	0.75903	9.88028
	$PtCl_6$	0.91876	9.96320
Pt	$H_2PtCl_6 \cdot 6H_2O$	2.6537	10.42385
	K_2PtCl_6	2.4902	10.39623
	$(NH_4)_2 PtCl_6$	2.2745	10.35688

GRAVIMETRIC FACTORS AND THEIR LOGARITHMS
(Continued)

Weighed	Sought	Factor	Logarithm
Platinum:			−10
Pt	$PtCl_4$	1.7265	10.23716
	$PtCl_4 \cdot 5H_2C$	2.1879	10.34002
$PtCl_4$	K_2PtCl_6	1.4423	10.15907
	$(NH_4)_2$ $PtCl_6$	1.3174	10.11972
	Pt	0.57921	9.76284
$PtCl_6$	$(NH_4)_2$ $PtCl_6$	1.0884	10.03680
$PtCl_4 \cdot 5H_2O$	K_2PtCl_6	1.1382	10.05621
	Pt	0.45707	9.65998
Potassium K = 39.096			
Ag	KBr	1.1032	10.04265
	KCl	0.69108	9.83953
	$KClO_3$	1.1360	10.05539
	$KClO_4$	1.2843	10.10867
	KCN	0.60349	9.78067
	KI	1.5390	10.18724
AgBr	KBr	0.63373	9.80190
	$KBrO_3$	0.88932	9.94906
AgCl	KCl	0.52013	9.71611
	$KClO_3$	0.85500	9.93197
	$KClO_4$	0.96660	9.98525
AgCN	KCN	0.48627	9.68687
AgI	KI	0.70707	9.84948
	KIO_3	0.91148	9.95975
$BaCrO_4$	K_2CrO_4	0.76642	9.88447
	$K_2Cr_2O_7$	0.58056	9.76385
$BaSO_4$	$KHSO_4$	0.58334	9.76592
	K_2S	0.47232	9.67424
	K_2SO_4	0.74650	9.87303
Br	K	0.48921	9.68950
	KBr	1.4892	10.17295
CaF_2	$KF \cdot 2H_2O$	2.4114	10.38227
$CaSO_4$	$KF \cdot 2H_2O$	1.3829	10.14078
Cl	K	1.1027	10.04244
	KCl	2.1027	10.32277
	$KClO_3$	3.4565	10.53863
	$KClO_4$	3.9076	10.59191
	K_2O	1.3283	10.12328
CO_2	K_2O	2.1407	10.33056
	K_2CO_3	3.1407	10.49703
I	KI	1.3080	10.11661
	KIO_3	1.6862	10.22690
K	Br	2.0441	10.31050
	Cl	0.90690	9.95756
	KBr	3.0441	10.48345
	KCl	1.9069	10.28033
	$KClO_3$	3.1347	10.49620
	$KClO_4$	3.5439	10.54948
	KI	4.2466	10.62804
	K_2O	1.2046	10.08084
	KNO_3	2.5860	10.41263
	K_2PtCl_6	6.2174	10.79361
	K_2SO_4	2.2285	10.34802

Weighed	Sought	Factor	Logarithm
Potassium			−10
K	Pt	2.4968	10.39738
K_3AsO_4	$Mg_2As_2O_7$	0.60597	9.78245
KBr	Ag	0.90646	9.95735
	AgBr	1.5780	10.19810
	Br	0.67150	9.82705
	K	0.32851	9.51655
	K_2O	0.39572	9.59739
$KBrO_3$	AgBr	1.1244	10.05094
KCl	Ag	1.4470	10.16047
	AgCl	1.9226	10.28389
	Cl	0.47559	9.67723
	K	0.52441	9.71967
	$KClO_3$	1.6438	10.21585
	$KClO_4$	1.8584	10.26914
	K_2CO_3	0.92678	9.96698
	$K_2Cr_2O_7$	1.9731	10.29516
	$KHCO_3$	1.3427	10.12798
	KNO_3	1.3561	10.13230
	K_2O	0.63170	9.80051
	K_2PtCl_6	3.2605	10.51328
	K_2SO_4	1.1684	10.06769
	Pt	1.3093	10.11705
$KClO_3$	Ag	0.88026	9.94461
	AgCl	1.1696	10.06803
	Cl	0.28931	9.46137
	KCl	0.60833	9.78414
$KClO_4$	Ag	0.77865	9.89133
	AgCl	1.0345	10.01475
	Cl	0.25591	9.40809
	K	0.28218	9.45053
	KCl	0.53810	9.73086
	K_2O	0.33992	9.53137
KCN	AgCN	2.0565	10.31313
	Ag	1.6570	10.21932
K_2CO_3	CO_2	0.31840	9.50297
	KCl	1.0790	10.03302
	KOH	0.81197	9.90954
	K_2O	0.68160	9.83353
	K_2PtCl_6	3.5180	10.54630
	K_2SO_4	1.2610	10.10071
K_2CrO_4	$BaCrO_4$	1.3048	10.11553
$K_2Cr_2O_7$	$BaCrO_4$	1.7225	10.23615
	KCl	0.50680	9.70484
	K_2O	0.32015	9.50535
$KF \cdot 2H_2O$	CaF_2	0.41470	9.61773
	$CaSO_4$	0.72313	9.85922
K_2HAsO_4	$Mg_2As_2O_7$	0.71177	9.85234
$KHCO_3$	KCl	0.74477	9.87202
	K_2O	0.47047	9.67253
	K_2PtCl_6	2.4283	10.38530
	K_2SO_4	0.87038	9.93971
$KHSO_4$	$BaSO_4$	1.7143	10.23408
	K_2SO_4	0.63986	9.80608
KI	Ag	0.64977	9.81276
	AgI	1.4143	10.15054
	I	0.76452	9.88339
	K	0.23548	9.37196

GRAVIMETRIC FACTORS AND THEIR LOGARITHMS
(Continued)

Weighed	Sought	Factor	Logarithm
Potassium			−10
KI	K_2O	0.28366	9.45280
KIO_3	AgI	1.0971	10.04025
	I	0.59306	9.77310
K_2MnO_4	Mn_2O_3	0.40041	9.60250
	MnS	0.44132	9.64475
$KMnO_4$	Mn_2O_3	0.49947	9.69851
	MnS	0.55050	9.74076
KNO_2	K_2SO_4	1.0238	10.01021
	N_2O_3	0.44661	9.64993
KNO_3	K	0.38670	9.58737
	KCl	0.73740	9.86770
	K_2O	0.46581	9.66821
	K_2PtCl_6	2.4043	10.38098
	K_2SO_4	0.86177	9.93539
	N	0.13855	9.14161
	NH_3	0.16846	9.22649
	NO	0.29681	9.47247
	N_2O_5	0.53419	9.72769
K_2O	Cl	0.75287	9.87672
	CO_2	0.46713	9.66944
	K	0.83016	9.91916
	KBr	2.5270	10.40261
	KCl	1.5830	10.19949
	$KClO_3$	2.6022	10.41534
	$KClO_4$	2.9419	10.46863
	K_2CO_3	1.4671	10.16647
	$K_2Cr_2O_7$	3.1236	10.49465
	$KHCO_3$	2.1256	10.32747
	KI	3.5253	10.54720
	KOH	1.1913	10.07601
	KNO_3	2.1468	10.33179
	K_2PtCl_6	5.1614	10.71277
	K_2SO_4	1.8500	10.26718
	N_2O_5	1.1468	10.05948
KOH	K_2CO_3	1.2316	10.09046
	K_2O	0.83944	9.92399
K_2PtCl_6	K	0.16084	9.20639
	K_2CO_3	0.28425	9.45370
	KCl	0.30671	9.48672
	$KHCO_3$	0.41181	9.61470
	KNO_3	0.41593	9.61902
	K_2O	0.19375	9.28723
	K_2SO_4	0.35843	9.55441
	$K_2SO_4 \cdot Al_2(SO_4)_3 \cdot 24H_2O$	1.9515	10.29038
	$K_2SO_4 \cdot Cr_2(SO_4)_3 \cdot 24H_2O$	2.0546	10.31272
K_2S	$BaSO_4$	2.1172	10.32576
	K_2SO_4	1.5805	10.19879
K_2SiO_3	SiO_2	0.38937	9.59036
K_2SO_4	$BaSO_4$	1.3396	10.12697
	KCl	0.85568	9.93231
	K_2CO_3	0.79303	9.89929
	$KHCO_3$	1.1489	10.06029
	$KHSO_4$	1.5629	10.19392

Weighed	Sought	Factor	Logarithm
Potassium			−10
K_2SO_4	KNO_2	0.97676	9.98979
	KNO_3	1.1604	10.06461
	K	0.44871	9.65196
	K_2O	0.54053	9.73282
	K_2PtCl_6	2.7899	10.44559
	K_2S	0.63271	9.80121
	SO_3	0.45946	9.66225
$K_2SO_4 \cdot Al_2(SO_4)_3 \cdot 24H_2O$	K_2PtCl_6	0.51241	9.70962
$K_2SO_4 \cdot Cr_2(SO_4)_3 \cdot 24H_2O$	K_2PtCl_6	0.48672	9.68728
$Mg_3As_2O_7$	K_3AsO_4	1.6503	10.21755
	K_2HAsO_4	1.4049	10.14766
Mn_2O_3	K_2MnO_4	2.4975	10.39750
	$KMnO_4$	2.0021	10.30149
MnS	K_2MnO_4	2.2659	10.35525
	$KMnO_4$	1.8165	10.25924
N	KNO_3	7.2175	10.85839
NH_3	KNO_3	5.9363	10.77351
NO	KNO_3	3.3692	10.52753
N_2O_3	KNO_2	2.2391	10.35007
N_2O_5	K_2O	0.87200	9.94052
	KNO_3	1.8720	10.27231
Pt	K	0.40052	9.60262
	KCl	0.76375	9.88295
SiO_2	K_2SiO_3	2.5683	10.40964
SO_3	K_2SO_4	2.1765	10.33775
Praseodymium Pr = 140.92			
Pr	Pr_2O_3	1.1703	10.06830
Pr_2O_3	Pr	0.85447	9.93170
Rhodium: Rh = 102.91			
Rh	Na_3RhCl_6	3.7377	10.57260
	$RhCl_3$	2.0336	10.30827
$RhCl_3$	Rh	0.49173	9.69173
Na_3RhCl_6	Rh	0.26755	9.42741
Rubidium: Rb = 85.44			
AgCl	Rb	0.59608	9.77530
	RbCl	0.84345	9.92606
Cl	Rb	2.4097	10.38196
	RbCl	3.4097	10.53272
Rb	AgCl	1.6776	10.22469
	Cl	0.41499	9.61804
	RbCl	1.4150	10.15076
	Rb_2CO_3	1.3511	10.13069
	Rb_2O	1.0936	10.03886

GRAVIMETRIC FACTORS AND THEIR LOGARITHMS
(Continued)

Weighed	Sought	Factor	Logarithm
Rubidium:			−10
Rb	Rb_2PtCl_6	3.3875	10.52988
	Rb_2SO_4	1.5622	10.19374
RbCl	AgCl	1.1856	10.07394
	Cl	0.29328	9.46728
	Rb	0.70672	9.84925
	Rb_2CO_3	0.95486	9.97994
	Rb_2O	0.77289	9.88812
	Rb_2PtCl_6	2.3940	10.37912
	Rb_2SO_4	1.1040	10.04297
Rb_2CO_3	Rb	0.74012	
	RbCl	1.0473	10.02007
	$RbHCO_3$	1.2686	10.10332
	Rb_2PtCl_6	2.5072	10.39919
	Rb_2SO_4	1.1562	10.06303
$RbHCO_3$	Rb_2CO_3	0.78827	9.89668
	Rb_2PtCl_6	1.9763	10.29585
	Rb_2SO_4	0.91140	9.95971
Rb_2O	Rb	0.91438	9.96113
	RbCl	1.2938	10.11187
	Rb_2PtCl_6	3.0975	10.49101
	Rb_2SO_4	1.4284	10.15485
Rb_2PtCl_6	Rb	0.29520	9.47012
	RbCl	0.41771	9.62087
	Rb_2CO_3	0.39886	9.60082
	$RbHCO_3$	0.50600	9.70415
	Rb_2O	0.32285	9.50900
Rb_2SO_4	Rb	0.64013	9.80627
	RbCl	0.90579	9.95703
	Rb_2CO_3	0.86490	9.93697
	$RbHCO_3$	1.0972	10.04029
	Rb_2O	0.70007	9.84514
Selenium: Se = 79.2			
Se	H_2SeO_3	1.6315	10.21259
	H_2SeO_4	1.8335	10.26328
	SeO_2	1.4040	10.14737
	SeO_3	1.6061	10.20577
H_2SeO_3	Se	0.61293	9.78741
H_2SeO_4	Se	0.54539	9.73672
SeO_2	Se	0.71223	9.85263
SeO_3	Se	0.62264	9.79423
Silicon: Si = 28.06			
$BaSiF_6$	SiF_4	0.37239	9.57100
	SiO_2	0.21494	9.33231
H_2SiO_3	SiO_2	0.76925	9.88607
K_2SiF_6	SiF_4	0.47246	9.67436
	SiO_2	0.27269	9.43567
Si	SiO_2	2.1404	10.33050
SiF_4	$BaSiF_6$	2.6854	10.42900
	K_2SiF_6	2.1166	10.32564
	SiO_2	0.57718	9.76131
SiO_2	$BaSiF_6$	4.6526	10.66769
	H_2SiO_3	1.3000	10.11393
Silicon:			
SiO_2	K_2SiF_6	3.6672	10.56433
	Si	0.46720	9.66950
	SiF_4	1.7326	10.23869
	SiO_3	1.2664	10.10257
	SiO_4	1.5328	10.18548
	Si_2O	0.60040	9.77844
	$Si(OH)_4$	1.5999	10.20410
SiO_3	SiO_2	0.78964	9.89743
SiO_4	SiO_2	0.65241	9.81452
Si_2O	SiO_2	1.6656	10.22156
$Si(OH)_4$	SiO_2	0.62503	9.79590
Silver: Ag = 107.880			
Ag	AgBr	1.7408	10.24075
	AgCl	1.3287	10.12342
	AgCN	1.2411	10.09380
	AgI	2.1766	10.33778
	$AgNO_3$	1.5748	10.19723
	Ag_2O	1.0742	10.03107
	Ag_3PO_4	1.2936	10.11181
	$Ag_4P_2O_7$	1.4034	10.14717
AgBr	Br	0.74080	9.86970
	Cl	0.32867	9.51676
	I	1.1766	10.07063
	Ag	0.57445	9.75925
	Br	0.42555	9.62895
AgCl	Ag	0.75263	9.87658
	$AgNO_3$	1.1852	10.07380
	Ag_2O	0.80844	9.90765
	Br	0.55754	9.74628
	Cl	0.24737	9.39334
AgCN	Ag	0.80575	9.90620
$AgNO_3$	Ag	0.63501	9.80278
	AgCl	0.84371	9.92619
AgI	Ag	0.45943	9.66222
	I	0.54056	9.73285
Ag_2O	Ag	0.93095	9.96891
	AgCl	1.2369	10.09235
Ag_3PO_4	Ag	0.77302	9.88819
$Ag_4P_2O_7$	Ag	0.71257	9.85283
Br	Ag	1.3499	10.13030
	AgBr	2.3499	10.37105
	AgCl	1.7936	10.25372
Cl	Ag	3.0426	10.48324
	AgCl	4.0426	10.60666
I	Ag	0.84900	9.92937
	AgI	1.8499	10.26715
Sodium: Na = 22.997			
Ag	NaBr	0.95396	9.97953
	NaCl	0.54184	9.73387
	NaI	1.3898	10.14294
AgBr	NaBr	0.54800	9.73878
AgCl	NaCl	0.40780	9.61045
	$NaClO_3$	0.74268	9.87080

GRAVIMETRIC FACTORS AND THEIR LOGARITHMS
(Continued)

Weighed	Sought	Factor	Logarithm
Sodium:			−10
AgCl	$NaClO_4$	0.85431	9.93162
AgI	NaI	0.63850	9.80516
$BaSO_4$	$NaHSO_4$	0.51436	9.71127
	$NaHSO_4 \cdot H_2O$	0.59154	9.77198
	Na_2S	0.33439	9.52426
	Na_2SO_3	0.54003	9.73241
	$Na_2SO_3 \cdot 7H_2O$	1.0803	10.03354
	Na_2SO_4	0.60856	9.78430
	$Na_2SO_4 \cdot 10H_2O$	1.3804	10.13999
B_2O_3	$Na_2B_4O_7$	1.4451	10.15990
	$Na_2B_4O_7 \cdot 10H_2O$	2.7386	10.43753
Br	Na	0.28776	9.45903
	NaBr	1.2877	10.10983
	Na_2O	0.38786	9.58868
$CaCl_2$	NaCl	1.0534	10.02258
$CaCO_3$	Na_2CO_3	1.0592	10.02499
CaF_2	NaF	1.0759	10.03177
CaO	Na_2CO_3	1.8904	10.27656
$CaSO_4$	Na_2CO_3	0.77862	9.89132
Cl	Na	0.64859	9.81197
	NaCl	1.6486	10.21711
	Na_2O	0.87422	9.94162
CO_2	Na_2CO_3	2.4090	10.38184
	Na_2O	1.4090	10.14890
H_3BO_3	$Na_2B_4O_7$	0.81364	9.91043
	$Na_2B_4O_7 \cdot 10H_2O$	1.5419	10.18806
I	Na	1.8118	9.25810
	NaI	1.1812	10.07231
	Na_2O	0.24420	9.38775
KBF_4	$Na_2B_4O_7$	0.39962	9.60165
	$Na_2B_4O_7 \cdot 10H_2O$	0.75732	9.87928
$Mg_2As_2O_7$	Na_2HAsO_3	1.0946	10.03924
	Na_2HAsO_4	1.1976	10.07831
$MgCl_2$	NaCl	1.2276	10.08905
$Mg_2P_2O_7$	Na_2HPO_4	1.2756	10.10570
	$Na_2HPO_4 \cdot 12H_2O$	3.2172	10.50748
	$NaNH_4HPO_4 \cdot 4H_2O$	1.8782	10.27375
	$Na_4P_2O_7 \cdot 10H_2O$	2.0036	10.30182
Na	Br	3.4752	10.54097
	Cl	1.5418	10.18803
	I	5.5195	10.74190
	NaBr	4.4751	10.65080
	NaCl	2.5418	10.40514
	Na_2CO_3	2.3046	10.36259
	$NaHCO_3$	3.6529	10.56264
	NaI	6.5194	10.81421
	Na_2O	1.3479	10.12965
Sodium:			−10
Na	Na_2SO_4	3.0886	10.48976
$Na_2B_4O_7$	B_2O_3	0.69199	9.84010
	H_3BO_3	1.2291	10.08957
	KBF_4	2.5024	10.39835
$Na_2B_4O_7 \cdot 10H_2O$	B_2O_3	0.36515	9.56247
	H_3BO_3	0.64854	9.81194
	KBF_4	1.3205	10.12072
NaBr	Ag	1.0483	10.02047
	AgBr	1.8248	10.26122
	Br	0.77655	9.89017
	Na	0.22346	9.34920
	Na_2O	0.30120	9.47885
NaCl	Ag	1.8456	10.26613
	AgCl	2.4522	10.38955
	Cl	0.60659	9.78289
	Na	0.39343	9.59486
	$NaClO_3$	1.8212	10.26036
	$NaClO_4$	2.0949	10.32116
	Na_2CO_3	0.90668	9.95745
	$NaHCO_3$	1.4371	10.15750
	Na_2HPO_4	1.2149	10.08454
	Na_2O	0.53029	9.72451
	Na_2SO_4	1.2151	10.08462
$NaClO_3$	AgCl	1.3465	10.12921
	NaCl	0.54910	9.73965
$NaClO_4$	AgCl	1.1705	10.06837
	NaCl	0.47735	9.67884
Na_2CO_3	CaCO	0.94408	9.97501
	CaO	0.52898	9.72344
	$CaSO_4$	1.2843	10.10868
	CO_2	0.41511	9.61816
	Na	0.43392	9.63741
	NaCl	1.1029	10.04255
	$NaHCO_3$	1.5851	10.20005
	Na_2O	0.58487	9.76706
	NaOH	0.75485	9.87786
	Na_2SO_4	1.3402	10.12717
$Na_2CO_3 \cdot 10H_2O$	Na_2SO_4	0.49643	9.69586
NaF	CaF_2	0.92946	9.96823
Na_2HAsO_3	$Mg_2As_2O_7$	0.91360	9.96075
$Na_2HAsO_4 \cdot 10H_2O$	$Mg_2As_2O_7$	0.83500	9.92169
$NaHCO_3$	Na	0.27376	9.43736
	NaCl	0.69583	9.84250
	Na_2CO_3	0.63089	9.79995
	Na_2O	0.36898	9.56701
$NaNH_4HPO_4 \cdot 4H_2O$	$Mg_2P_2O_7$	0.53241	9.72625
	NH_3	0.081438	8.91083
	P_2O_5	0.33962	9.53099
Na_2HPO_4	$Mg_2P_2O_7$	0.78397	9.89430
	NaCl	0.82313	9.91547
	Na_2O	0.43649	9.63997

GRAVIMETRIC FACTORS AND THEIR LOGARITHMS
(Continued)

Weighed	Sought	Factor	Logarithm
Sodium:			−10
Na_2HPO_4	$Na_4P_2O_7$	0.93658	9.97154
	P_2O_5	0.50008	9.69904
Na_2HPO_4· $12H_2O$.	$Mg_2P_2O_7$	0.31083	9.49252
	$Na_4P_2O_7$	0.37133	9.56976
	P_2O_5	0.19827	9.29726
NaH SO_3	SO_2	0.61559	9.78929
$NaHSO_4$.	$BaSO_4$	1.9441	10.28873
$NaHSO_4$· H_2O	$BaSO_4$	1.6905	10.22802
NaI	Ag	0.71955	9.85706
	AgI	1.5662	10.19484
	I	0.84662	9.92769
	Na	0.15339	9.18579
	Na_2O	0.20675	9.31544
$NaNO_3$.	Na_2O	0.36464	9.56187
	N	0.16479	9.21693
	NH_3	0.20036	9.30181
	NO	0.35302	9.54779
	N_2O_5	0.63534	9.80301
Na_2O	Br	2.5782	10.41132
	Cl	1.1439	10.05838
	CO_2	0.70974	9.85110
	I	4.0950	10.61225
	Na	0.74190	9.87035
	NaBr	3.3201	10.52115
	NaCl	1.8858	10.27549
	Na_2CO_3	1.7098	10.23294
	$NaHCO_3$	2.7101	10.43299
	NaI	4.8368	10.68456
	Na_2HPO_4	2.2910	10.36003
	$NaNO_3$	2.7424	10.43813
	NaOH	1.2906	10.11080
	Na_2SO_4	2.2914	10.36011
	N_2O_5	1.7424	10.24114
	SO_3	1.2915	10.11109
NaOH	Na_2CO_3	1.3248	10.12214
	Na_2O	0.77482	9.88920
$Na_4P_2O_7$	Na_2HPO_4	1.0677	10.02845
	Na_2HPO_4· $12H_2O$	2.6930	10.43024
$Na_4P_2O_7$· $10H_2O$.	$Mg_2P_2O_7$	0.49909	9.69818
Na_2S	$BaSO_4$	2.9905	10.47574
Na_2SO_3	$BaSO_4$	1.8518	10.26759
	SO_2	0.50821	9.70604
Na_2SO_3· $7H_2O$	$BaSO_4$	0.92568	9.96646
	SO_2	0.25405	9.40491
Na_2SO_4	$BaSO_4$	1.6433	10.21570
	Na	0.32377	9.51024
	NaCl	0.82296	9.91538
	Na_2CO_3	0.74615	9.87283
	Na_2CO_3· $10H_2O$	2.0144	10.30414
Sodium:			−10
Na_2SO_4	Na_2O	0.43641	9.63989
	SO_3	0.56361	9.75098
Na_2SO_4· $10H_2O$.	$BaSO_4$	0.72445	9.86001
	N	0.6083	10.78307
NH_3	$NaNO_3$	4.9910	10.69819
	$NaNH_4HP$ O_4·$4H_2O$	12.279	11.08917
NO	$NaNO_3$	2.8328	10.45221
N_2O_5	$NaNO_3$	1.5740	10.19699
	Na_2O	0.57393	9.75886
P_2O_5	Na_2HPO_4	1.9997	10.30096
	Na_2HPO_4· $12H_2O$	5.0436	10.70274
	$NaNH_4HP$ O_4·$4H_2O$	2.9445	10.46901
SO_2	$NaHSO_3$	1.6245	10.21071
	Na_2SO_3	1.9677	10.29396
	Na_2SO_3· $7H_2O$	3.9363	10.59509
SO_3	Na_2O	0.77430	9.88891
	Na_2SO_4	1.7743	10.24902
Stron- tium: Sr = 87.63			
CO_2	$SrCO_3$	3.3553	10.52573
SO_3	SrO	1.2944	10.11205
	$SrSO_4$	2.2944	10.36066
Sr	$SrCO_3$	1.6847	10.22653
	$Sr(NO_3)_2$	2.4152	10.38295
	SrO	1.1826	10.07284
	$SrSO_4$	2.0963	10.32145
$SrCl_2$	$SrCO_3$	0.93118	9.96903
	SrO	0.65364	9.81534
	$SrSO_4$	1.1586	10.06395
$SrCO_3$	CO_2	0.29804	9.47427
	Sr	0.59357	9.77347
	$SrCl_2$	1.0739	10.03097
	$Sr(HCO_3)_2$	1.4201	10.15231
	$Sr(NO_3)_2$	1.4336	10.15643
	SrO	0.70195	9.84631
	$SrSO_4$	1.2443	10.09492
$Sr(HCO_3)_2$	$SrCO_3$	0.70419	9.84769
	SrO	0.49431	9.69400
$Sr(NO_3)_2$	Sr	0.41404	9.61704
	$SrCO_3$	0.69754	9.84357
	SrO	0.48964	9.68988
	$SrSO_4$	0.86794	9.93849
SrO	SO_3	0.77260	9.88795
	Sr	0.84560	9.92716
	$SrCl_2$	1.5295	10.18466
	$SrCO_3$	1.4246	10.15369
	$Sr(HCO_3)_2$	2.0230	10.30600
	$Sr(NO_3)_2$	2.0423	10.31012
	$SrSO_4$	1.7726	10.24861

GRAVIMETRIC FACTORS AND THEIR LOGARITHMS
(Continued)

eighed	Sought	Factor	Loga-rithm	Weighed	Sought	Factor	Laga-rithm
on-ium: SO4	SO_3	0.43585	9.63934	Tellurium: Te	$H_2TeO_4 \cdot 2H_2O$	1.8004	10.25537
	Sr	0.47703	9.67855		TeO_2	1.2510	10.09726
	$SrCl_2$	0.86308	9.93605		TeO_3	1.3765	10.13878
	$SrCO_3$	0.80368	9.90508		$(TeO_2)_2SO_3$	1.5650	10.19451
	$Sr(NO_3)_2$	1.1522	10.06151	H_2TeO_4	Te	0.65886	9.81879
	SrO	0.56414	9.75139	$H_2TeO_4 \cdot 2H_2O$	Te	0.55544	9.74464
phur: = 2.064				TeO_2	Te	0.79937	9.90275
				TeO_3	Te	0.72650	9.86124
2S3	H_2S	0.41542	9.61849	$(TeO_2)_2$ SO_3	Te	0.63900	9.80550
SO4	S	0.39085	9.59201	Thallium: Tl = 204.39			
	FeS2	0.25696	9.40987				
	H_2S	0.14600	9.16434				
	H_2SO_3	0.35163	9.54608				
	H_2SO_4	0.42016	9.62342	Tl	Tl_2CO_3	1.1468	10.05948
	S	0.13736	9.13786		TlCl	1.1735	10.06948
	SO_2	0.27444	9.43845		Tl_2CrO_4	1.2838	10.10850
	SO_3	0.34299	9.53528		$TlHSO_4$	1.4749	10.16876
	SO_4	0.41153	9.61440		TlI	1.6210	10.20978
lS	H_2S	0.23589	9.37271		$TlNO_3$	1.3034	10.11508
	S	0.22194	9.34623		Tl_2O	1.0391	10.01666
S2	$BaSO_4$	3.8916	10.59013		Tl_2PtCl_6	1.9980	10.30060
S	As_2S_3	2.4072	10.38151		Tl_2SO_4	1.2350	10.09167
	$BaSO_4$	6.8495	10.83566	Tl_2CO_3	Tl	0.87201	9.94052
	CdS	4.2393	10.62729		Tl_2PtCl_6	1.7423	10.24112
	SO_3	2.3493	10.37094	TlCl	Tl	0.85217	9.93053
SO3	$BaSO_4$	2.8439	10.45392		Tl_2PtCl_6	1.7027	10.23114
SO4	$BaSO_4$	2.3800	10.37658	Tl_2CrO_4	Tl	0.77894	9.89150
	$(NH_4)_2SO_4$	1.3473	10.12947	$TlHSO_4$	Tl	0.67800	9.83123
	SO_3	0.81632	9.91186	TlI	Tl	0.61689	9.79021
$H_4)_2$ SO4	SO_3	0.60589	9.78239		Tl_2PtCl_6	1.2326	10.09082
	H_2SO_4	0.74222	9.87053	$TlNO_3$	Tl	0.76724	9.88493
	As_2S_3	2.5585	10.40799		Tl_2PtCl_6	1.5329	10.18551
	$BaSO_4$	7.2802	10.86214	Tl_2O	Tl	0.96233	9.98332
	CdS	4.5058	10.65377		Tl_2PtCl_6	1.9228	10.28393
2	$BaSO_4$	3.6438	10.56155	Tl_2PtCl_6	Tl	0.50049	9.69940
2	$BaSO_4$	2.9155	10.46472		TlCl	0.58732	9.76887
	H_2S	0.42566	9.62906		Tl_2CO_3	0.57396	9.75888
	$(NH_4)_2SO_4$	1.6505	10.21762		TlI	0.81132	9.90919
4	$BaSO_4$	2.4299	10.38560		$TlNO_3$	0.65234	9.81447
talum: a = 1.5					Tl_2O	0.52010	9.71609
					Tl_2SO_4	0.61811	9.79107
				Tl_2SO_4	Tl	0.80971	9.90833
	Ta_2O_5	1.2204	10.08650	Thorium: Th = 232.15	Tl_2PtCl_6	1.6178	10.20892
	$TaCl_5$	1.9768	10.29596				
Cl5	Ta	0.50587	9.70404				
	Ta_2O_5	0.61736	9.79054	Th	ThO_2	1.1378	10.05607
2O4	Ta_2O_5	1.0375	10.01539	$ThCl_4$	ThO_2	0.70632	9.84900
2O5	Ta	0.81941	9.91350	$Th(NO_3)_4 \cdot 6H_2O$	ThO_2	0.44902	9.65227
	$TaCl_5$	1.6198	10.20946				
	Ta_2O_4	0.96388	9.98402	ThO_2	Th	0.87886	9.94392
urium: e = 7.5					$ThCl_4$	1.4158	10.15100
					$Th(NO_3)_4 \cdot 6H_2O$	2.2271	10.34774
	H_2TeO_4	1.5178	10.18121				

GRAVIMETRIC FACTORS AND THEIR LOGARITHMS
(Continued)

Weighed	Sought	Factor	Logarithm	Weighed	Sought	Factor	Logarithm
Tin: Sn = 118.70			−10	Uranium: $(UO_2)_2P_2O_7$	U	0.66677	9.823
Sn	$SnCl_2$	1.5974	10.20342	$U_2P_2O_{11}$	U	0.66677	9.823
	$SnCl_2 \cdot 2H_2O$	1.9010	10.27898		UO_2	0.75637	9.879
	$SnCl_4$	2.1949	10.34141	Vanadium V = 50.96			
	$SnCl_4 \cdot (NH_4Cl)_2$	3.0963	10.49084		V_2O_5	1.7849	10.251
	SnO	1.1348	10.05492		VO_4	0.79122	9.898
	SnO_2	1.2696	10.10367		V_2O_5	0.56025	9.748
$SnCl_2$	Sn	0.62601	9.79658		V	1.2639	10.101
	SnO_2	0.79477	9.90024		VO_4		
$SnCl_2 \cdot 2H_2O$	Sn	0.52604	9.72102	Ytterbium: Yb = 173.6			
	SnO_2	0.66785	9.82468		Yb	1.1382	10.056
$SnCl_4$	Sn	0.45561	9.65859		Yb_2O_3	0.87854	9.943
	SnO_2	0.57843	9.76225				
$SnCl_4(NH_4Cl)_2$	Sn	0.32297	9.50916	Yttrium: Y = 88.9			
	SnO_2	0.41004	9.61283		Y_2O_3	1.2700	10.103
SnO	Sn	0.88122	9.94508		Y	0.78742	9.896
	SnO_2	1.1188	10.04875				
SnO_2	Sn	0.78766	9.89634	Zinc: Zn = 65.38			
	$SnCl_2$	1.2582	10.09976		$BaSO_4$	0.41744	9.620
	$SnCl_2 \cdot 2H_2O$	1.4973	10.17532		$ZnSO_4 \cdot 7H_2O$	1.2319	10.090
	$SnCl_4$	1.7289	10.23775	Zn	$ZnNH_4PO_4$	2.7294	10.436
	$SnCl_4(NH_4Cl)_2$	2.4388	10.38718		ZnO	1.2447	10.095
	SnO	0.89383	9.95125		$Zn_2P_2O_7$	2.3311	10.367
Titanium: Ti = 48.1					ZnS	1.4904	10.173
Ti	TiO_2	1.6652	10.22148	$ZnCl_2$	ZnO	0.59709	9.776
TiO_2	Ti	0.60051	9.77852	$ZnCO_3$	ZnO	0.64907	9.812
Tungsten: W = 184.				$ZnNH_4PO_4$	Zn	0.36638	9.564
W	WO_2	1.1739	10.06963		ZnO	0.45605	9.659
	WO_3	1.2609	10.10067	ZnO	Zn	0.80338	9.905
WO_2	W	0.85187	9.93037		$ZnCl_2$	1.6748	10.224
WO_3	W	0.79310	9.89933		$ZnCO_3$	1.5407	10.188
Uranium: U = 238.17					$ZnNH_4PO_4$	2.1928	10.341
					$Zn_2P_2O_7$	1.8727	10.272
					ZnS	1.1974	10.078
					$ZnSO_4 \cdot 7H_2O$	2.7471	10.439
U	UO_2	1.1344	10.05475	$Zn_2P_2O_7$	Zn	0.42898	9.632
	$(UO_2)_2P_2O_7$	1.4998	10.17603		ZnO	0.53398	9.727
	U_3O_8	1.1792	10.07157	ZnS	$BaSO_4$	2.3955	10.379
	$U_2P_2O_{11}$	1.4998	10.17602		Zn	0.67093	9.827
UO_2	U	0.88156	9.94525		ZnO	0.83514	9.921
	U_3O_8	1.0395	10.01682		$ZnSO_4 \cdot 7H_2O$	2.9509	10.469
	$U_2P_2O_{11}$	1.3221	10.12127	$ZnSO_4 \cdot 7H_2O$	$BaSO_4$	0.81178	9.909
U_3O_8	U	0.84806	9.92843		ZnO	0.28301	9.451
	UO_2	0.96200	9.98318		ZnS	0.33888	9.530
	$UO_2(NO_3)_2 \cdot 6H_2O$	1.7885	10.25249	Zirconium Zr = 91.22			
$UO_2(NO_3)_2 \cdot 6H_2O$	U_3O_8	0.55913	9.74751	Zr	ZrO_2	1.3516	10.131
				ZrO_2	Zr	0.73984	9.869

CERAMICS

PROPERTIES OF CERAMIC

From Andrews: Ceramic Tests and Calculations

	Material	Formula	Molecular or formula weight
1	Acetic acid	CH_3COOH	60.0
2	Alcohol	C_2H_5OH	46.0
3	Albite (Soda spar)	$Na_2OAl_2O_36SiO_2$	525.1
4	Alum (ammonium)	$Al_2(SO_4)_3 \cdot (NH_4)_2SO_4 \cdot 24H_2O$	906.7
5	Alum (potash)	$Al_2(SO_4)_3K_2SO_4 \cdot 24H_2O$	948.8
6	Alumina (oxide)	Al_2O_3	101.9
7	Aluminum hydrate	$Al_2O_3 \cdot 3H_2O$	156.0
8	Aluminum sulfate	$Al_2(SO_4)_3 \cdot 18H_2O$	666.4
9	Aluminum sulfate (anhyd.)	$Al_2(SO_4)_3$	342.1
10	Ammonia (solution)	NH_4OH	35.0
11	Ammonium carbonate	$(NH_4)_2CO_3H_2O$	114.1
12	chloride	NH_4Cl	53.5
13	nitrate	NH_4NO_3	80.05
14	sulfate	$(NH_4)_2SO_4$	132.1
15	Andalusite	$Al_2O_3SiO_2$	162.3
16	Anorthite (Feldspar)	$CaOAl_2O_32SiO_2$	278.7
17	Apatite	Variable $[Ca_3(PO_4)_2]$	
18	Antimony oxide	Sb_2O_3	291.5
19	Arsenous oxide	As_2O_3	197.8
20	Barium carbonate	$BaCO_3$	197.4
21	chloride	$BaCl_2 \cdot 2H_2O$	244.3
22	chromate	$BaCrO_4$	253.5
23	hydroxide	$Ba(OH)_2 \cdot 8H_2O$	315.5
24	oxide	BaO	153.4
25	peroxide	BaO_2	169.4
26	sulfate	$BaSO_4$	233.4
27	Bismuth oxide	Bi_2O_3	466.0
28	Bone ash (approx.)	$4Ca_3(PO_4)_2 \cdot CaCO_3$	1340
29	Boracic acid (boric acid)	$B_2O_3 \cdot H_2O$	123.7
30	Boric oxide	B_2O_3	69.6
31	Borax (sodium tetra-borate)	$Na_2B_4O_7 \cdot 10H_2O$	381.4
32	Borax (melted)		201.3
33	Calcium borate (colemanite)	$Ca(BO_2)_2 \cdot 2H_2O$	161.7
34	carbonate	$CaCO_3$	100.1
35	chloride	$CaCl_2 \cdot 6H_2O$	219.1
36	chloride (anhyd.)	$CaCl_2$	111.0
37	Calcium fluoride (fluorspar)	CaF_2	78.1
38	hydroxide	$Ca(OH)_2$	74.1
39	oxide	CaO	56.1
40	phosphate (ortho)	$Ca_3(PO_4)_2$	310.3
41	sulfate (gypsum)	$CaSO_4 \cdot 2H_2O$	172.2
42	Carbon dioxide	CO_2	44.0
43	monoxide	CO	28.0
44	Chromium sulfate	$Cr_2(SO_4)_3 \cdot 18H_2O$	716.5
45	sesquioxide (black)	Cr_2O_6	152.0
46	Chrome alum	$Cr_2(SO_4)_3 \cdot K_2SO_4 \cdot 24H_2O$	998.9
47	Clay (kaolinite)	$Al_2O_3 \cdot 2SiO_2 \cdot 2H_2O$	258.1
48	Cobaltic chloride	Co_2Cl_6	330.6
49	oxide, sesqui	Co_2O_3	165.9
50	oxide	Co_3O_4	240.8
51	Cobaltous acetate	$Co(CH_3COO)_2 \cdot 4H_2O$	249.0
52	carbonate	$CoCO_3$	119.0
53	chloride	$CoCl_2 \cdot 6H_2O$	238.0
54	nitrate	$Co(NO_3)_2 \cdot 6H_2O$	291.1

AW MATERIALS

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Equivalent weight			Melting point, degrees C.	Specific gravity	Solubility
RO	R_2O_3	RO_2			
.....	.....	.....	.....	.....	S
.....	.....	.....	.....	0.785	S
525.1	525.1	87.5	.....	2.5–2.65	I
906.7	906.7	.....	94.5	1.645	S
948.8	948.8	.....	84.5	1.757	S
.....	101.9	.....	2050	3.73–3.99	I
.....	156.9	.....	D 300	2.423	I
.....	666.4	.....	D	1.62	S
.....	342.1	.....	D 770	2.71	S
35.0	.....	35.0	D	.....	S
114.1	.....	114.1	85	.....	S
53.5	.....	53.5	550	1.520	S
80.05	.....	80.05	169.6	1.725	S
132.1	.....	132.1	513	1.769	S
.....	162.3	162.3	.....	3–3.4	I
278.7	278.7	139.4	.....	.....	I
.....	.....	.....	.....	.....	...
.....	291.5	.....	red heat	5.2–5.67	I
.....	197.8	.....	200	3.738–3.865	Sl
197.4	.....	197.4	D 900, M 1360	4.275	Sl
244.3	.....	.....	960	3.856	S
253.5	507.0	.....	.....	4.498	I
315.5	.....	.....	780	1.656	Sl
153.4	.....	.....	O_2 450	5.32–5.74	Sl
169.4	.....	.....	.....	4.96	I
233.4	.....	233.4	1580	4.476–4.330	I
.....	466.0	.....	820–860	8.8–9.0	I
.....	.....	.....	.....	.....	I
.....	123.7	.....	184–186	1.4347	S
.....	69.6	.....	577	1.75–1.83	S
381.4	190.7	.....	red heat	1.694	S
201.3	100.6	.....	732	2.367	S
161.7	161.7	.....	.....	.....	Sl
100.1	.....	.....	D 825	2.72–2.95	I
219.1	.....	.....	30.2	1.654	S
111.0	.....	.....	774	2.152	S
78.1	.....	.....	1300	3.15–3.18	I
74.1	.....	.....	D 580	2.078	Sl
56.1	.....	.....	2570	3.13–3.40	Sl
206.8	310.3	.....	1550	3.8	I
172.2	.....	.....	D 900	2.32	Sl
.....	.....	44.0	.....	A1.53	...
.....	.....	.....	.....	A0.967	...
.....	716.5	.....	.....	.....	S
.....	152.0	.....	1990	5.215	I
998.9	998.9	.....	89	1.813	S
.....	258.1	128.6	.....	.....	I
165.3	330.6	.....	Sublimes	2.94	S
83.0	165.9	.....	O_2–895	4.81–5.60	I
80.2	160.5	.....	O_2–905	5.8–6.3	I
249.0	498.0	.....	.....	1.7043	S
119.0	238.0	.....	D	.....	I
238.0	476.0	.....	86.75	1.84	S
291.1	582.2	.....	56	1.883	S

PROPERTIES OF CERAMIC

	Material	Formula	Molecular or formula weight
1	Cobaltous oxide	CoO	74.9
2	phosphate	$Co_3(PO_4)_2 \cdot 3H_2O$	420.9
3	silicate	Co_2SiO_4	210.1
4	sulfate	$CoSO_4 \cdot 7H_2O$	281.1
5	Copper acetate	$Cu(CH_3COO)_2 \cdot H_2O$	199.6
6	Cryolite	Na_3AlF_6	285.0
7	Cupric carbonate (basic)	$CuCO_3 \cdot Cu(OH)_2$	221.2
8	chloride	$CuCl_2 \cdot 2H_2O$	170.5
9	hydroxide	$Cu(OH)_2$	97.6
10	nitrate	$Cu(NO_3)_2 \cdot 6H_2O$	295.7
11	oxide	CuO	79.6
12	sulfate	$CuSO_4 \cdot 5H_2O$	249.7
13	Cuprous chloride	Cu_2Cl_2	198.0
14	hydroxide	$CuOH$	80.6
15	oxide	Cu_2O	143.1
16	sulfate	$Cu_2SO_4 \cdot H_2O$	225.2
17	Dolomite	$CaCO_3 \cdot MgCO_3$	184.4
18	Feldspar (potash)	$K_2O \cdot Al_2O_3 \cdot 6SiO_2$	556.8
19	(soda)	$Na_2O \cdot Al_2O_3 \cdot 6SiO_2$	524.5
20	Ferric chloride	Fe_2Cl_6	324.4
21	hydroxide	$Fe(OH)_3$	106.9
22	oxide (red)	Fe_2O_3	159.7
23	phosphate	$FePO_4 \cdot 4H_2O$	222.9
24	sulfate	$Fe_2(SO_4)_2 \cdot 9H_2O$	562.0
25	Ferro-ferric oxide (magnetic)	Fe_3O_4	231.5
26	Ferrous oxide	FeO	71.8
27	carbonate	$FeCO_3$	115.8
28	sulfate	$FeSO_4 \cdot 7H_2O$	278.0
29	sulfide (pyrite)	FeS	87.9
30	Flint	SiO_2	60.06
31	Gypsum	$CaSO_4 \cdot 2H_2O$	172.2
32	Hydrogen peroxide	H_2O_2	34.0
33	sulfide	H_2S	34.1
34	Hydrochloric acid (muriatic)	HCl	36.5
35	Hydrofluoric acid	HF	20.0
36	Kaolinite	$Al_2O_3 \cdot 2SiO_2 \cdot 2H_2O$	258.1
37	Lead acetate	$Pb(CH_3COO)_2 \cdot 3H_2O$	379.3
38	antimonate	Variable	.....
39	borate	$Pb(BO_2)_2 \cdot H_2O$	310.9
40	carbonate	$PbCO_3$	267.2
41	carbonate (basic) (white lead)	$2PbCO_3 \cdot Pb(OH)_2$	775.6
42	chloride	$PbCl_2$	278.1
43	chromate	$PbCrO_4$	323.2
44	dioxide	PbO_2	239.2
45	oxide (litharge)	PbO	223.2
46	red	Pb_3O_4	685.6
47	sulfate	$PbSO_4$	303.3
48	sulfide (galena)	PbS	239.3
49	Lithium carbonate	Li_2CO_3	73.9
50	Magnesium carbonate	$MgCO_3$	84.3
51	chloride	$MgCl_2 \cdot 6H_2O$	203.3
52	oxide	MgO	40.3
53	Magnesium sulfate (Epsom salts)	$MgSO_4$	120.4
54	crystals	$MgSO_4 \cdot 7H_2O$	246.5
55	Manganese dioxide (black)	MnO_2	86.9

AW MATERIALS (Continued)

Equivalent weight			Melting point, degrees C.	Specific gravity	Solubility
RO	R_2O_3	RO_2			
74.9	149.8	.....	O_2–28.60	5.6–5.75	I
140.3	280.6	.....	.....	.....	I
105.0	210.1	.....	.....	4.63	I
281.1	562.2	.....	96.8	1.948	S
199.6	.....	.....	D 240	1.9	S
190.0	570.0	.....	.....	2.9–3.0	I
221.2	.....	.....	D	3.7–4.0	I
170.5	.....	.....	D 100	2.47–2.54	S
97.6	.....	.....	D	3.368	I
295.7	.....	.....	26.4	2.074	S
79.6	.....	.....	1064	6.32–6.43	I
249.7	.....	.....	D 110	2.284	S
99.0	.....	.....	425	3.38–3.68	S
80.6	.....	.....	D 360	.....	I
71.6	.....	.....	1210	5.75–6.09	I
112.6	.....	.....	.....	3.83–4.46	S
184.4	.....	.....	.....	.....	I
556.8	556.8	92.9	.....	.....	I
524.5	524.5	87.6	.....	.....	I
162.2	324.4	.....	303	2.804	S
106.9	213.8	.....	D 500	3.4–3.9	I
79.8	159.7	.....	1548	5.12–5.24	I
222.9	445.8	.....	.....	2.87	I
281.0	562.0	.....	.....	2–2.1	S
77.2	154.4	.....	1538	4.96–5.40	I
71.8	143.6	.....	1419	.....	I
115.8	231.6	.....	D 470–880	4.70–3.87	I
278.0	556.0	.....	D 64	1.8987	S
87.9	175.8	.....	1197	4.75–5.40	I
.....	.....	60.06	1600–1750	2.20–2.65	I
172.2	.....	.....	D 900	2.32	S
.....	.....	.....	.....	.....	S
.....	.....	.....	.....	.....	S
.....	.....	.....	.....	.....	S
.....	.....	.....	.....	.....	S
.....	258.1	129.0	.....	.....	I
379.3	.....	.....	D 75	2.50	S
.....	.....	.....	.....	.....	I
310.9	621.8	.....	red heat	.....	I
267.2	.....	.....	.....	6.43	I
258.5	.....	.....	D	.....	I
278.1	.....	.....	498	5.885	I
323.2	646.4	.....	D 600	6.123	I
239.2	.....	.....	D 290	9.36	I
223.2	.....	.....	red heat	8.74–9.5	I
228.5	.....	.....	D 500	9.096	I
303.3	.....	.....	1170	6.23	I
239.3	.....	.....	1015	7.13–7.7	I
73.9	.....	.....	618–710	2.111	Sl
84.3	.....	.....	D 350	3.04	I
203.3	.....	.....	D 100	1.569	S
40.3	.....	.....	2800	3.22–3.654	I
120.4	.....	.....	.....	2.65	S
246.5	.....	.....	.....	1.678	S
86.9	.....	.....	O_2 535	5.026	I

PROPERTIES OF CERAMI

	Material	Formula	Molecular or formula weight
1	Manganic oxide (brownish black)	Mn_2O_3	157.9
2	sulfate	$Mn_2(SO_4)_3$	398.0
3	Manganous carbonate	$MnCO_3$	114.9
4	chloride	$MnCl_2 \cdot 4H_2O$	197.9
5	oxide	MnO	70.9
6	sulfate	$MnSO_4 \cdot 4H_2O$	223.0
7	sulfate	$MnSO_4 \cdot 7H_2O$	277.1
8	Mercuric chloride	$HgCl_2$	271.5
9	nitrate	$Hg(NO_3)_2 \cdot 2H_2O$	342.6
10	oxide	HgO	216.6
11	sulfate	$HgSO_4$	296.7
12	sulfate (basic)	$2HgO \cdot HgSO_4$	729.9
13	sulfide	HgS	232.7
14	Mercurous oxide	Hg_2O	417.2
15	Molybdic acid	$H_2MoO_4 \cdot H_2O$	180.0
16	Nickel chloride	$NiCl_2$	129.6
17	chloride (hydrated)	$NiCl_2 \cdot 6H_2O$	237.7
18	oxide	NiO	74.7
19	sulfate	$NiSO_4$	154.8
20	sulfate	$NiSO_4 \cdot 6H_2O$	262.8
21	sulfate	$NiSO_4 \cdot 7H_2O$	280.9
22	Niter	KNO_3	101.1
23	Niter soda	$NaNO_3$	85.0
24	Nitric acid	HNO_3	63.0
25	Potassium carbonate (pearl ash)	K_2CO_3	138.0
26	chromate	K_2CrO_4	194.2
27	chloride	KCl	74.6
28	dichromate	$K_2Cr_2O_7$	294.2
29	nitrate (saltpeter)	KNO_3	101.1
30	ferrocyanide	$K_4Fe(CN)_6 \cdot 3H_2O$	422.4
31	hydroxide	KOH	56.1
32	oxide	K_2O	94.2
33	permanganate	$KMnO_4$	158.0
34	Silica (silicon dioxide)	SiO_2	60.1
35	Silicic acid	H_2SiO_3	78.1
36	Sodium bicarbonate	$NaHCO_3$	84.0
37	carbonate (crystals)	$Na_2CO_3 \cdot 10H_2O$	286.2
38	carbonate (anhyd.)	Na_2CO_3	106.0
39	chromate	$Na_2CrO_4 \cdot 10H_2O$	342.2
40	chloride (salt)	$NaCl$	58.4
41	dichromate	$Na_2Cr_2O_7 \cdot 2H_2O$	298.0
42	hydroxide (caustic)	$NaOH$	40.0
43	nitrate (soda nitre)	$NaNO_3$	85.0
44	meta-antimonate	$Na_2Sb_2O_3 \cdot 7H_2O$	510.1
45	oxide	Na_2O	62.0
46	silicate	Variable composition	
47	sulfate	$Na_2SO_4 \cdot 10H_2O$	322.2
48	uranate	Na_2UO_4	348.2
49	Stannic acid (ortho)	H_2SnO_3	168.7
50	chloride	$SnCl_4$	260.5
51	oxide	SnO_2	150.7
52	Stannous chloride	$SnCl_2$	189.6
53	oxide	SnO	134.7
54	Strontium carbonate	$SrCO_3$	147.6
55	oxide	SrO	103.6
56	sulfate, celestite	$SrSO_4$	183.7

RAW MATERIALS (Continued)

	Equivalent weight			Melting point, degrees C.	Specific gravity	Solubility
	RO	R_2O_3	RO_2			
1	78.9	157.9	.....	O_2 1080	4.325–4.82	I
2	199.0	.....	.....	D	.....	S
3	114.9	.....	.....	D	3.125–3.66	I
4	197.9	.....	.....	87.5	1.913	S
5	70.9	.....	.....	white heat	5.09–5.18	I
6	223.0	.....	.....	.....	2.107	S
7	277.1	.....	.....	D 280	2.092	S
8	271.5	.....	.....	277	5.32–5.46	S
9	342.6	.....	.....	D	.....	S
10	216.6	.....	.....	D	11.00–11.29	I
11	296.7	.....	.....	D red heat	6.466	D
12	243.3	.....	.....	.....	6.44	I
13	232.7	.....	.....	Sub. 466	7.55–8.12	I
14	208.6	.....	.....	D	8.95–10.69	I
15	.....	.....	.....	.....	3.124	Sl
16	129.6	.....	.....	Sub.	2.65	S
17	237.7	.....	.....	.....	.....	S
18	74.7	.....	.....	O_2 400	6.6–6.8	I
19	154.8	.....	.....	SO_3 840	3.418	S
20	262.8	.....	.....	D 280	2.031	S
21	280.9	.....	.....	98–100	1.98	S
22	202.2	.....	.....	337	2.106	S
23	170.0	.....	.....	310	2.267	S
24	.....	.....	.....	.....	.....	S
25	138.0	.....	.....	869	2.3312	S
26	194.2	288.4	.....	975	2.7319	S
27	149.1	.....	.....	772	1.987	S
28	294.2	294.2	.....	397.5	2.692	S
29	202.2	.....	.....	337	2.1062	S
30	211.2	422.4	.....	.....	1.8533	S
31	112.2	.....	.....	360.4	2.044	S
32	94.2	.....	.....	red heat	2.32	S
33	316.0	.....	.....	D 240	2.7032	S
34	60.1	.....	.....	1600–1750	2.20–2.65	I
35	.....	.....	78.1	.....	1.576	S
36	168.0	.....	.....	D 270	2.19–2.22	S
37	286.2	.....	.....	.....	1.446	S
38	106.0	.....	.....	849	2.43–2.51	S
39	342.2	684.4	.....	.....	2.71	S
40	116.9	.....	.....	801	2.16	S
41	298.0	298.0	.....	.....	2.52	S
42	80.0	.....	.....	318	2.13	S
43	170.0	.....	.....	310	2.27	S
44	510.1	1020.2	.....	.....	.....	...
45	62.0	.....	.....	red heat	2.25	S
46	.....	.....	.....	.....	.....	...
47	322.2	.....	.....	32	1.492	S
48	348.2	.....	.....	.....	.....	I
49	.....	.....	168.7	.....	.....	Sl
50	.....	.....	260.5	.....	2.28	S
51	.....	.....	150.7	1127	6.6–6.9	I
52	.....	.....	189.6	247.2	.....	S
53	.....	.....	.....	D	6.3	I
54	147.6	.....	.....	D 1075	3.62	I
55	103.6	.....	.....	3000	4.45–4.75	I
56	183.7	.....	.....	1605	3.71–3.97	I

PROPERTIES OF CERAMIC

	Material	Formula	Molecular or formula weight
1	Sulfur dioxide	SO_2	64.1
2	trioxide	SO_3	80.1
3	Sulfuric acid	H_2SO_4	98.1
4	Titanium oxide	TiO_2	80.1
5	Tin oxide	SnO_2	150.7
6	Uranium oxide	UO_2	270.2
7	oxide	UO_3	286.2
8	Zinc carbonate	$ZnCO_3$	125.4
9	oxide	ZnO	81.4
10	sulfate	$ZnSO_4 \cdot 7H_2O$	287.6
11	Zirconium oxide (zirconia)	ZrO_2	123.0
12	silicate (zircon)	$ZrSiO_4$	182.9

RAW MATERIALS (Continued)

	Equivalent weight			Melting point, degrees C.	Specific gravity	Solubility
	RO	R_2O_3	RO_2			
1	.....	.....	.....	.....	A 2.2639	S
2	.....	.....	.....	16.8	A 2.75	S
3	.....	.....	.....	10.46	1.834	S
4	.....	.....	80.1	1560	3.75–4.25	I
5	.....	.....	150.7	1127	6.6–6.9	I
6	.....	.....	270.2	2176	10.95	I
7	286.2	.....	286.2	D	5.02–5.26	I
8	125.4	.....	.....	CO_2 300	4.42–4.45	I
9	81.4	.....	.....	.....	5.78	I
10	287.6	.....	.....	D 50	1.966	S
11	.....	.....	123.0	2700	5.75	I
12	182.9	.....	182.9	.....	.....	I

FACTORS FOR CALCULATING THE PROPERTIES OF GLASSES

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Composition	Thermal expansion, W. & S.* $\times 10^{-7}$	Thermal expansion, M. & H.† $\times 10^{-7}$	Thermal expansion, E. & T.‡ $\times 10^{-7}$	Heat conductivity, Paalhorn	Density in glass W. & S.*	Density, Baillie's	Tensile strength, W. & S.*	Crushing strength, W. & S.*	Elasticity, C. & T. * *	Hardness, Auerbach	Specific gravity
SiO_2	0.8	0.8	0.15	0.0220	2.3	2.24	0.09	1.23	40	+ 3.32	0.001913
Al_2O_3	5.0	5.0	0.52	0.0220	4.1	2.75	0.05	1.0	120	+10.1	.....
B_2O_3	0.1	0.1	−1.98	0.0160	1.9	3.00	0.065	0.90	...	+ 0.75	0.002272
As_2O_5	2.0	2.0	.....	.....	4.1	2.90	0.03	1.00	...	.....	0.001276
P_2O_5	2.0	2.0	.....	0.0160	2.55	....	0.075	0.76	...	+ 1.32	0.001903
Na_2O	10:0	10.0	12.96	0.0160	2.6	3.20	0.02	0.52	110	− 2.65	0.002674
K_2O	8.5	8.5	11.7	0.0010	2.8	3.20	0.01	0.05	...	+ 3.9	0.001860
PbO	3.0	4.2	3.18	0.0080	9.6	10.30	0.025	0.48	...	+ 1.45	0.000512
ZnO	1.8	2.1	0.21	0.0160	5.9	5.94	0.15	0.6	...	+ 7.1	0.001245
CaO	5.0	5.0	4.89	0.0320	3.3	4.30	0.20	0.20	240	− 6.3	0.001903
MgO	0.1	0.1	1.35	.....	3.8	3.25	0.01	1.1	300	.....	0.002439
BaO	3.0	3.0	5.2	0.0110	7.0	7.20	0.05	0.65	...	+ 1.95	0.000673
Na_3AlF_6	....	7.4	.....	.....	....	....	....	....	...	.....	.....
NaF	....	7.4	.....	.....	....	....	....	....	...	.....	.....
Cr_2O_3	....	5.1	.....	.....	....	....	....	....	...	.....	.....
CoO	....	4.4	.....	.....	....	....	....	....	...	.....	.....
AlF_3	....	4.4	.....	.....	....	....	....	....	...	.....	.....
TiO_2	....	4.1	.....	.....	....	....	....	....	...	.....	.....
Fe_2O_3	....	4.0	.....	.....	....	....	....	....	...	.....	.....
NiO	....	4.0	.....	.....	....	....	....	....	...	.....	.....
Sb_2O_5	....	3.6	.....	.....	....	....	....	....	...	.....	.....
CaF_2	....	2.5	.....	.....	....	....	....	....	...	.....	.....
MnO_2	....	2.2	.....	.....	....	....	....	....	...	.....	.....
SnO_2	....	2.0	.....	.....	....	....	....	....	...	.....	.....
CuO	....	2.2	.....	.....	....	....	....	....	...	.....	.....
ZrO_2	....	2.1	0.69	.....	....	....	....	....	...	.....	.....

* Winkelman and Shott. ‡ English and Turner, J. Amer. Ceram. Soc., X, 551 (1927).
† Mayer and Havas. * * Clark and Turner.

FUNDAMENTAL DATA RELATING TO SIEVES OF THE STANDARD SCREEN SCALE

From "Report of Committee on Standards," A.C.S. Year Book, 1921–1922

Sieve No.	Sieve opening, millimeters	Sieve opening, inches	Wire diameter, millimeters	Wire diameter, inches	Tolerance in average opening, per cent	Tolerance in wire diameter, per cent	Tolerance in maximum opening, per cent	Mesh per cm.	Mesh per inch
2½	8.00	0.315	1.85	0.073	1	5	10	1	2.6
3	6.72	0.265	1.65	0.065	1	5	10	1.2	3.0
3½	5.66	0.223	1.45	0.057	1	5	10	1.4	3.6
4	4.76	0.187	1.27	0.050	1	5	10	1.7	4.2
5	4.00	0.157	1.12	0.044	1	5	10	2	5.0
6	3.36	0.132	1.02	0.040	1	5	10	2.3	5.8
7	2.83	0.111	0.92	0.036	1	5	10	2.7	6.8
8	2.38	0.094	0.84	0.033	2	5	10	3	7.9
10	2.00	0.079	0.76	0.030	2	5	10	3.5	9.2
12	1.68	0.066	0.69	0.027	2	5	10	4	10.8
14	1.41	0.0557	0.61	0.024	2	5	10	5	12.5
16	1.19	0.0468	0.54	0.021	2	5	10	6	14.7
18	1.00	0.0394	0.48	0.0187	2	5	10	7	17.2
20	0.84	0.0331	0.42	0.0165	3	5	25	8	20.2
25	0.71	0.0278	0.37	0.0146	3	5	25	9	23.6
30	0.59	0.0234	0.33	0.0129	3	5	25	11	27.5
35	0.50	0.0197	0.29	0.0113	3	5	25	13	32.3
40	0.42	0.0166	0.25	0.0098	3	5	25	15	37.9
45	0.35	0.0139	0.22	0.0085	3	5	25	18	44.7
50	0.30	0.0117	0.188	0.0074	4	10	40	20	52.4
60	0.25	0.0098	0.162	0.0064	4	10	40	24	61.7
70	0.21	0.0083	0.140	0.0055	4	10	40	29	72.5
80	0.177	0.0070	0.119	0.0047	4	10	40	34	85.5
100	0.149	0.0059	0.102	0.0040	4	10	40	40	101
120	0.125	0.0049	0.086	0.0034	4	10	40	47	120
140	0.105	0.0041	0.074	0.0029	5	15	60	56	143
170	0.088	0.0035	0.063	0.0025	5	15	60	66	167
200	0.074	0.0029	0.053	0.0021	5	15	60	79	200
230	0.062	0.0025	0.046	0.0018	5	15	60	93	233
270	0.053	0.0021	0.041	0.0016	5	15	60	106	270
325	0.044	0.0017	0.036	0.0014	5	15	60	125	323

END POINTS AND INTERVALS OF PYROMETRIC CONES

Fairchild and Peters

From Andrews: Ceramic Tests and Calculations, John Wiley and Sons, publishers, by permission

The temperatures in the following table, which have been determined under standardized and reproducible conditions (controlled rate of heating in clean air) will apply with fair approximation for the cones when heated in kilns where the gases are normally oxidizing and free from sulfur oxides. If the cones show a visible hardening of the surface or a skin effect resulting from exposure to kiln gases containing insufficient oxygen, small corrections may be necessary. Such surface action is most frequently noticed with cones 015 to 01. In kilns fired with fuel containing appreciable amounts of sulfur, or where the ware gives off sulfur dioxide the end points may be noticeably different from those given in the table.

Rate °C. per hour Cone No.	20° C. End point °C.	150° C. End point °C.	20° C. Bending interval °C.	150° C. Bending interval °C.	20° C. Cone interval °C.	150° C. Cone interval °C.
022	585	605	45	55	10	10
021	595	615	45	45	30	35
020	625	650	30	25	5	10
019	630	660	30	20	40	60
018	670	720	30	30	50	50
017	720	770	30	30	15	25
016	735	795	35	55	35	10
015	770	805	30	45	25	25
014	795	830	45	40	30	30
013	825	860	45	50	15	15
012	840	875	50	85	35	30
011	875	905	65	65	15	−10
010	890	895	30	25	40	35
09	930	930	35	40	15	20
08	945	950	55	60	30	40
07	975	990	35	50	30	25
06	1005	1015	25	35	25	25
05	1030	1040	30	30	20	20
04	1050	1060	40	40	30	55
03	1080	1115	40	35	15	10
02	1095	1125	35	35	15	20
01	1110	1145	50	45	15	15
1	1125	1160	30	45	10	5
2	1135	1165	30	45	10	5
3	1145	1170	30	40	20	20
4	1165	1190	40	35	15	15
5	1180	1205	40	50	10	25
6	1190	1230	40	35	20	20
7	1210	1250	40	60	15	10
8	1225	1260	45	55	25	25
9	1250	1285	65	115	10	20
10	1260	1305	40	95	25	20

ND POINTS AND INTERVALS OF PYROMETRIC CONES (Continued)

Rate °C. per hour Cone No.	20° C. End point °C.	150° C. End point °C.	20° C. Bending interval °C.	150° C. Bending interval °C.	20° C. Cone interval °C.	150° C. Cone interval °C.
11	1285	1325	70	80	25	10
12	1310	1335	80	45	40	15
13	1350	1350	70	55	40	50
14	1390	1400	100	70	20	35
15	1410	1435	85	115	40	30
16	1450	1465	70	125	15	10
17	1465	1475	50–75	125	20	15
18	1485	1490	90	85	30	30
19	1515	1520	100	70	5	10
20	1520	1530	..	60	..	50
23	....	1580	..	30	..	15
26	....	1595	..	10	..	10
27	....	1605	..	15	..	10
28	....	1615	..	10	..	25
29	....	1640	..	30	..	10
30	....	1650	..	25	..	30
31	....	1680	..	25	..	20
32	....	1700	..	15	..	45
33	....	1745	..	30	..	15
34	1755	1760	..	15	..	25
35	1775	1785	..	15	..	25
36	1810	1810	..	25	..	10
37	1830	1820	..	5	..	15
38	1850	1835	..	15	..	..
39	1865	....	..	..	..	..
40	1885	....	..	..	..	..
41	1970	....	..	..	..	..
42	2015	....	..	..	..	..

SHRINKAGE CONVERSION TABLES

A. E. R. Westman: Journal of the American Ceramic Society, Vol. II, No. 9, Sept. 1928, reprinted by permission

Relations between Linear and Volume Change

Nature of change	Percentage basis	Equations* for converting: Volume change to linear change	Linear change to volume change	Percentage basis	Nature of change
Expansion	Initial values	$a = 100\left[\sqrt[3]{\frac{b}{100}+1}-1\right]$ Equation (4) (Table II)	$b = 100\left[\left(\frac{a}{100}+1\right)^3-1\right]$ Equation (6) (Table II)	Final values	Contraction (or shrinkage)
	Final values	$a = 100\left[\sqrt[3]{\frac{b}{100}-1+1}\right]$ Equation (5) (Table I)	$b = 100\left[\left(\frac{a}{100}-1\right)^3+1\right]$ Equation (7) (Table I)	Initial values	

* In the equations, a = % linear change, b = % volume change, and substitutions are to be made arithmetically.

Conversion of Percentage Basis

Nature of change in size	Equations* for converting: Percentage of initial value to final value	Percentage of final value to initial value
Expansion	$c = \frac{100d}{100+d}$ Equation (8)	$d = \frac{100c}{100-c}$ Equation (10) (Table III)
Contraction	$c = \frac{100d}{100-d}$ Equation (9) (Table III)	$d = \frac{100c}{100+c}$ Equation (11)

* In the equations, c = % change based on final value and d = % change based on initial value; substitutions are made arithmetically.

CALCULATION OF DESIGN FACTORS, COMBINATION OF CHANGES

Nature of changes	Percentage basis	Equation* for calculating resultant per cent change	Percentage basis	Nature of changes
Both expansions	Initial values	$Z = X + Y + \frac{XY}{100}$ Equation (12)	Final values	Both contractions (or shrinkages)
	Final values	$Z = X + Y - \frac{XY}{100}$ Equation (13)	Initial values	

* In the equations, Z = per cent resultant change or overall change, X = per cent change in first process (*e.g.* drying) and Y = per cent change in second process (*e.g.* firing). If X and Y are percentages of initial values, Z will be a percentage of the initial value; if X and Y are percentages of final values, Z will be a percentage of the final value.

For a complete explanation of the use of the tables the reader should consult the original paper.

TABLE I

Four Figure Table for Converting:
(1) Volume Drying Shrinkage (per cent of plastic volume) to Linear Drying Shrinkage per cent of plastic length.
(2) Volume Firing Shrinkage (per cent of unfired or dry volume) to Linear Firing Sbrinkage (per cent of unfired or dry length), and
(3) Volume Expansion (per cent of final volume) to Linear Expansion (per cent of final length).

Per cent volume change	Per cent volume change										Per cent volume change	Differences
	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9		
	Per cent linear change											
0	0.000	0.033	0.067	0.100	0.134	0.167	0.200	0.234	0.267	0.301	0	.034
1	0.334	0.368	0.402	0.435	0.469	0.503	0.536	0.570	0.604	0.638	1	.034
2	0.672	0.705	0.739	0.773	0.806	0.840	0.874	0.908	0.942	0.976	2	.034
3	1.010	1.044	1.078	1.112	1.146	1.181	1.215	1.249	1.283	1.317	3	.034
4	1.352	1.386	1.420	1.455	1.489	1.523	1.558	1.592	1.626	1.661	4	.034
5	1.695	1.730	1.764	1.799	1.834	1.868	1.903	1.937	1.972	2.007	5	.035
6	2.041	2.076	2.111	2.146	2.181	2.216	2.251	2.285	2.320	2.355	6	.035
7	2.390	2.425	2.460	2.495	2.530	2.565	2.600	2.636	2.671	2.706	7	.035
8	2.741	2.776	2.812	2.847	2.882	2.918	2.953	2.988	3.023	3.059	8	.035
9	3.095	3.130	3.166	3.201	3.237	3.273	3.308	3.344	3.380	3.415	9	.036
10	3.451	3.487	3.523	3.559	3.594	3.630	3.666	3.702	3.738	3.774	10	.036
11	3.810	3.846	3.882	3.918	3.954	3.990	4.027	4.063	4.099	4.135	11	.036
12	4.172	4.208	4.244	4.281	4.317	4.354	4.390	4.426	4.463	4.500	12	.036
13	4.536	4.572	4.609	4.646	4.683	4.719	4.756	4.793	4.830	4.866	13	.037
14	4.903	4.940	4.977	5.014	5.051	5.088	5.125	5.162	5.199	5.236	14	.037
15	5.273	5.310	5.348	5.385	5.422	5.459	5.497	5.534	5.571	5.609	15	.037
16	5.646	5.684	5.721	5.759	5.797	5.834	5.872	5.909	5.947	5.984	16	.037
17	6.022	6.060	6.098	6.136	6.174	6.212	6.249	6.287	6.325	6.363	17	.038

20	7.168	7.207	7.246	7.284	7.323	7.362	7.401	7.440	7.479	7.518	20	.039
21	7.557	7.596	7.635	7.674	7.713	7.752	7.791	7.831	7.870	7.909	21	.039
22	7.949	7.988	8.027	8.067	8.106	8.146	8.185	8.225	8.265	8.304	22	.039
23	8.344	8.383	8.423	8.463	8.503	8.543	8.582	8.622	8.662	8.702	23	.040
24	8.742	8.782	8.822	8.862	8.903	8.943	8.983	9.023	9.063	9.104	24	.040
25	9.144	9.184	9.225	9.265	9.306	9.346	9.387	9.428	9.468	9.509	25	.040
26	9.550	9.590	9.631	9.672	9.713	9.754	9.795	9.836	9.877	9.918	26	.040
27	9.959	10.00	10.04	10.08	10.12	10.16	10.21	10.25	10.29	10.33	27	.040
28	10.37	10.41	10.45	10.50	10.54	10.58	10.62	10.66	10.71	10.75	28	.040
29	10.79	10.83	10.87	10.91	10.96	11.00	11.04	11.08	11.13	11.17	29	.040
30	11.21	11.25	11.29	11.34	11.38	11.42	11.46	11.51	11.55	11.59	30	.040
31	11.63	11.68	11.72	11.76	11.81	11.85	11.89	11.93	11.98	12.02	31	.04
32	12.06	12.11	12.15	12.19	12.23	12.28	12.32	12.37	12.41	12.45	32	.04
33	12.50	12.54	12.58	12.63	12.67	12.72	12.76	12.80	12.85	12.89	33	.04
34	12.93	12.97	13.02	13.07	13.11	13.15	13.20	13.24	13.29	13.33	34	.04
35	13.38	13.42	13.47	13.51	13.55	13.60	13.64	13.69	13.74	13.78	35	.04
36	13.82	13.87	13.91	13.96	14.00	14.05	14.09	14.14	14.18	14.23	36	.04
37	14.27	14.32	14.36	14.41	14.46	14.50	14.55	14.59	14.64	14.68	37	.05
38	14.73	14.78	14.82	14.87	14.91	14.96	15.01	15.05	15.10	15.14	38	.05
39	15.19	15.24	15.28	15.33	15.38	15.42	15.47	15.52	15.56	15.61	39	.05
40	15.66	15.70	15.75	15.80	15.84	15.89	15.94	15.99	16.03	16.08	40	.05
41	16.13	16.18	16.23	16.27	16.32	16.37	16.41	16.46	16.51	16.56	41	.05
42	16.60	16.65	16.70	16.75	16.80	16.84	16.89	16.94	16.99	17.04	42	.05
43	17.09	17.14	17.18	17.23	17.28	17.33	17.38	17.43	17.48	17.53	43	.05
44	17.57	17.62	17.67	17.72	17.77	17.82	17.87	17.92	17.97	18.02	44	.05
45	18.07	18.12	18.17	18.22	18.27	18.32	18.37	18.42	18.47	18.52	45	.05
46	18.57	18.62	18.67	18.72	18.77	18.82	18.87	18.92	18.97	19.02	46	.05
47	19.07	19.12	19.18	19.23	19.28	19.33	19.38	19.43	19.48	19.53	47	.05
48	19.59	19.64	19.69	19.74	19.79	19.84	19.90	19.95	20.00	20.05	48	.05
49	20.10	20.16	20.21	20.26	20.31	20.37	20.42	20.47	20.52	20.58	49	.05
50	20.63	20.68	20.74	20.79	20.84	20.90	20.95	21.00	21.06	21.11	50	.05

TABLE II

Four Figure Table for Converting:
(1) Volume Drying Shrinkage (per cent of dry volume) to Linear Drying Shrinkage (per cent of dry length).
(2) Volume Firing Shrinkage (per cent of fired volume) to Linear Firing Shrinkage (per cent of fired length), and
(3) Volume Expansion (per cent of initial volume) to Linear Expansion (per cent of initial length).

Per cent volume change	Per cent volume change										Per cent volume change	Differences
	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9		
	Per cent linear change											
0	0.000	0.033	0.067	0.100	0.133	0.166	0.200	0.233	0.266	0.299	0	.033
1	0.332	0.365	0.398	0.431	0.464	0.497	0.530	0.563	0.596	0.629	1	.033
2	0.662	0.695	0.728	0.761	0.794	0.826	0.859	0.892	0.925	0.957	2	.033
3	0.990	1.023	1.055	1.088	1.121	1.153	1.186	1.218	1.251	1.283	3	.033
4	1.316	1.348	1.381	1.413	1.446	1.478	1.510	1.543	1.575	1.607	4	.032
5	1.640	1.672	1.704	1.736	1.769	1.801	1.833	1.865	1.897	1.929	5	.032
6	1.961	1.993	2.025	2.057	2.089	2.121	2.153	2.185	2.217	2.249	6	.032
7	2.281	2.313	2.345	2.376	2.408	2.440	2.472	2.503	2.535	2.567	7	.032
8	2.599	2.630	2.662	2.693	2.725	2.757	2.788	2.820	2.851	2.883	8	.032
9	2.914	2.946	2.977	3.009	3.040	3.071	3.103	3.134	3.165	3.196	9	.031
10	3.228	3.259	3.291	3.322	3.353	3.384	3.415	3.446	3.478	3.509	10	.031
11	3.540	3.571	3.602	3.633	3.664	3.695	3.726	3.757	3.788	3.819	11	.031
12	3.850	3.881	3.912	3.943	3.973	4.004	4.035	4.066	4.097	4.127	12	.031
13	4.158	4.189	4.219	4.250	4.281	4.311	4.342	4.373	4.403	4.434	13	.031
14	4.464	4.495	4.525	4.556	4.586	4.617	4.647	4.678	4.708	4.739	14	.030
15	4.769	4.799	4.830	4.860	4.890	4.921	4.951	4.981	5.011	5.042	15	.030
16	5.072	5.102	5.132	5.162	5.192	5.222	5.253	5.283	5.313	5.343	16	.030
17	5.373	5.403	5.433	5.463	5.493	5.523	5.553	5.583	5.612	5.642	17	.030
18	5.672	5.702	5.732	5.762	5.791	5.821	5.851	5.881	5.910	5.940	18	.030

20	6.266	6.295	6.325	6.354								
21	6.560	6.590	6.619	6.648	6.678	6.707	6.736	6.765	6.795	6.824	21	.029
22	6.853	6.882	6.911	6.940	6.970	6.999	7.028	7.057	7.086	7.115	22	.029
23	7.144	7.173	7.202	7.231	7.260	7.289	7.318	7.347	7.376	7.405	23	.029
24	7.434	7.463	7.491	7.520	7.549	7.578	7.607	7.635	7.664	7.693	24	.029
25	7.722	7.750	7.779	7.808	7.836	7.865	7.894	7.922	7.951	7.980	25	.029
26	8.008	8.037	8.065	8.094	8.122	8.151	8.179	8.208	8.236	8.265	26	.028
27	8.293	8.322	8.350	8.378	8.407	8.435	8.463	8.492	8.520	8.548	27	.028
28	8.577	8.605	8.633	8.661	8.690	8.718	8.746	8.774	8.802	8.831	28	.028
29	8.859	8.887	8.915	8.943	8.971	8.999	9.027	9.055	9.083	9.111	29	.028
30	9.139	9.167	9.195	9.223	9.251	9.279	9.307	9.335	9.363	9.391	30	.028
31	9.418	9.446	9.474	9.502	9.530	9.557	9.585	9.613	9.641	9.668	31	.028
32	9.696	9.724	9.751	9.779	9.807	9.834	9.862	9.890	9.917	9.945	32	.027
33	9.972	10.00	10.02	10.05	10.08	10.11	10.14	10.16	10.19	10.22	33	.03
34	10.25	10.27	10.30	10.33	10.36	10.38	10.41	10.44	10.47	10.49	34	.03
35	10.52	10.55	10.58	10.60	10.63	10.66	10.68	10.71	10.74	10.77	35	.03
36	10.79	10.82	10.85	10.87	10.90	10.93	10.96	10.98	11.00	11.03	36	.03
37	11.06	11.09	11.12	11.14	11.17	11.20	11.23	11.25	11.28	11.31	37	.03
38	11.33	11.36	11.39	11.41	11.44	11.47	11.49	11.52	11.55	11.57	38	.03
39	11.60	11.63	11.65	11.68	11.71	11.74	11.76	11.79	11.82	11.84	39	.03
40	11.87	11.90	11.92	11.95	11.98	12.00	12.03	12.05	12.08	12.11	40	.03
41	12.13	12.16	12.19	12.21	12.24	12.27	12.29	12.32	12.35	12.37	41	.03
42	12.40	12.43	12.45	12.48	12.50	12.53	12.56	12.58	12.61	12.64	42	.03
43	12.66	12.69	12.71	12.74	12.77	12.79	12.82	12.85	12.87	12.90	43	.03
44	12.92	12.95	12.98	13.00	13.03	13.05	13.08	13.11	13.13	13.16	44	.03
45	13.19	13.21	13.24	13.26	13.29	13.31	13.34	13.37	13.39	13.42	45	.03
46	13.44	13.47	13.50	13.52	13.55	13.57	13.60	13.62	13.65	13.68	46	.03
47	13.70	13.73	13.75	13.78	13.81	13.83	13.86	13.88	13.91	13.93	47	.03
48	13.96	13.99	14.01	14.04	14.06	14.09	14.11	14.14	14.17	14.19	48	.03
49	14.22	14.24	14.27	14.29	14.32	14.34	14.37	14.39	14.42	14.44	49	.03
50	14.47	14.50	14.52	14.55	14.57	14.60	14.62	14.65	14.67	14.70	50	.03

TABLE III

Four Figure Table for Converting:
(1) Drying Shrinkage (per cent of plastic size) to Drying Shrinkage (per cent of dry size).
(2) Firing Shrinkage (per cent of unfired or dry size) to Firing Shrinkage (per cent of fired size), and
(3) Expansion (per cent of final size) to Expansion (per cent of initial size).

Unconverted percentage	Unconverted percentage										Unconverted percentage	Differences
	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9		
	Converted percentage											
0	0.00	0.100	0.200	0.301	0.402	0.503	0.604	0.705	0.806	0.908	0	.101
1	1.010	1.112	1.215	1.317	1.420	1.523	1.626	1.729	1.833	1.937	1	.103
2	2.041	2.145	2.249	2.354	3.459	3.564	2.670	2.775	2.881	2.987	2	.105
3	3.093	3.199	3.306	3.413	3.520	3.627	3.734	3.842	3.950	4.058	3	.017
4	4.167	4.275	4.384	4.493	4.603	4.712	4.822	4.932	5.042	5.152	4	.110
5	5.263	5.374	5.485	5.597	5.708	5.820	5.932	6.045	6.157	6.720	5	.112
6	6.383	6.496	6.610	6.724	6.838	6.952	7.066	7.181	7.296	7.411	6	.114
7	7.527	7.643	7.759	7.875	7.991	8.108	8.225	8.342	8.460	8.578	7	.117
8	8.696	8.814	8.932	9.051	9.170	9.290	9.409	9.529	9.649	9.769	8	.119
9	9.890	10.01	10.13	10.25	10.38	10.50	10.62	10.74	10.86	10.99	9	.12
10	11.11	11.23	11.36	11.48	11.61	11.73	11.86	11.98	12.11	12.23	10	.12
11	12.36	12.49	12.61	12.74	12.87	12.99	13.12	13.25	13.38	13.51	11	.13
12	13.64	13.77	13.90	14.03	14.16	14.29	14.42	14.55	14.68	14.81	12	.13
13	14.94	15.07	15.21	15.34	15.47	15.61	15.74	15.87	16.01	16.14	13	.13
14	16.28	16.41	16.55	16.69	16.82	16.96	17.10	17.23	17.37	17.51	14	.14
15	17.65	17.79	17.92	18.06	18.20	18.34	18.48	18.62	18.76	18.91	15	.14
16	19.05	19.19	19.33	19.47	19.62	19.76	19.90	20.05	20.19	20.34	16	.14
17	20.48	20.63	20.77	20.92	21.07	21.21	21.36	21.51	21.65	21.80	17	.15
18	21.95	22.10	22.25	22.40	22.55	22.70	22.85	23.00	23.15	23.30	18	.15
19	23.46	23.61	23.76	23.92	24.07	24.22	24.38	24.53	24.69	24.84	19	.15

20	25.00	25.16	25.31	25.47	25.63	25.79	25.94	26.10	26.26	26.42	20	.16
21	26.58	26.74	26.90	27.06	27.23	27.39	27.55	27.71	27.88	28.04	21	.16
22	28.21	28.37	28.53	28.70	28.87	29.03	29.20	29.37	29.53	29.70	22	.17
23	29.87	30.04	30.21	30.38	30.55	30.72	30.89	31.06	31.23	31.41	23	.17
24	31.58	31.75	31.93	32.10	32.28	32.45	32.63	32.80	32.98	33.16	24	.18
25	33.33	33.51	33.69	33.87	34.05	34.23	34.41	34.59	34.77	34.95	25	.18
26	35.14	35.32	35.50	35.69	35.87	36.05	36.24	36.43	36.61	36.80	26	.19
27	36.99	37.17	37.36	37.55	37.74	37.93	38.12	38.31	38.50	38.70	27	.19
28	38.89	39.08	39.28	39.47	39.66	39.86	40.06	40.25	40.45	40.65	28	.20
29	40.85	41.04	41.24	41.44	41.64	41.84	42.05	42.25	42.45	42.65	29	.20
30	42.86	43.06	43.27	43.47	43.68	43.88	44.09	44.30	44.51	44.72	30	.21
31	44.93	45.14	45.35	45.56	45.77	45.99	46.20	46.41	46.63	46.84	31	.21
32	47.06	47.28	47.49	47.71	47.93	48.15	48.37	48.59	48.81	49.03	32	.22
33	49.25	49.48	49.70	49.93	50.15	50.38	50.60	50.83	51.06	51.29	33	.23
34	51.52	51.75	51.98	52.21	52.44	52.67	52.91	53.14	53.37	53.61	34	.23
35	53.85	54.08	54.32	54.56	54.80	55.04	55.28	55.52	55.76	56.01	35	.24
36	56.25	56.49	56.74	56.99	57.23	57.48	57.73	57.98	58.23	58.48	36	.25
37	58.73	58.98	59.24	59.49	59.74	60.00	60.26	60.51	60.77	61.03	37	.26
38	61.29	61.55	61.81	62.07	62.34	62.60	62.87	63.13	63.40	63.67	38	.26
39	63.93	64.20	64.47	64.74	65.02	65.29	65.56	65.84	66.11	66.39	39	.27
40	66.67	66.94	67.22	67.50	67.79	68.07	68.35	68.63	68.92	69.20	40	.28
41	69.49	69.78	70.07	70.36	70.65	70.94	71.23	71.53	71.82	72.12	41	.29
42	72.41	72.71	73.01	73.31	73.61	73.91	74.22	74.52	74.83	75.13	42	.30
43	75.44	75.75	76.06	76.37	76.68	76.99	77.30	77.62	77.94	78.25	43	.31
44	78.57	78.89	79.21	79.53	79.86	80.18	80.51	80.83	81.16	81.49	44	.32
45	81.82	82.15	82.48	82.82	83.15	83.49	83.82	84.16	84.50	84.84	45	.34
46	85.19	85.53	85.87	86.22	86.57	86.92	87.27	87.62	87.97	88.32	46	.35
47	88.68	89.04	89.39	89.75	90.11	90.48	90.84	91.20	91.57	91.94	47	.36
48	92.31	92.68	93.05	93.42	93.80	94.17	94.55	94.93	95.31	95.69	48	.38
49	96.08	96.46	96.85	97.24	97.63	98.02	98.41	98.81	99.20	99.60	49	.39
50	100.0	100.4	100.8	101.2	101.6	102.0	102.4	102.8	103.3	103.7	50	.4

TABLE IV

Four Figure Table for Converting:
(1) Drying Shrinkage (per cent of dry size) to Drying Shrinkage (per cent of plastic size).
(2) Firing Shrinkage (per cent of fired size) to Firing Shrinkage (per cent of unfired or dry size), and
(3) Expansion (per cent of initial size) to Expansion (per cent of final size).

Unconverted percentage	Unconverted percentage										Unconverted percentage	Differences
	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9		
	Converted percentage											
0	0.000	0.100	0.200	0.299	0.398	0.498	0.596	0.695	0.794	0.892	0	.099
1	0.990	1.088	1.186	1.283	1.381	1.478	1.575	1.672	1.768	1.865	1	.097
2	1.961	2.057	2.153	2.248	2.344	2.439	2.534	2.629	2.724	2.818	2	.095
3	2.913	3.007	3.101	3.195	3.288	3.382	3.475	3.568	3.661	3.754	3	.093
4	3.846	3.939	4.031	4.123	4.215	4.306	4.398	4.489	4.580	4.671	4	.091
5	4.762	4.853	4.943	5.033	5.123	5.213	5.303	5.393	5.482	5.571	5	.090
6	5.660	5.749	5.838	5.927	6.015	5.103	6.191	6.279	6.367	6.455	6	.088
7	6.542	6.629	6.716	6.803	6.890	6.977	7.063	7.149	7.236	7.322	7	.087
8	7.407	7.493	7.579	7.664	7.749	7.834	7.919	8.004	8.088	8.173	8	.085
9	8.257	8.341	8.425	8.509	8.592	8.676	8.759	8.842	8.925	9.008	9	.083
10	9.091	9.173	9.256	9.338	9.420	9.502	9.584	9.666	9.747	9.829	10	.082
11	9.910	9.991	10.07	10.15	10.23	10.31	10.39	10.47	10.55	10.63	11	.08
12	10.71	10.79	10.87	10.95	11.03	11.11	11.19	11.27	11.35	11.43	12	.08
13	11.50	11.58	11.66	11.74	11.92	11.89	11.97	12.05	12.13	12.20	13	.08
14	12.28	12.36	12.43	12.51	12.59	12.66	12.74	12.82	12.89	12.97	14	.08
15	13.04	13.12	13.19	13.27	13.34	13.42	13.49	13.57	13.64	13.72	15	.08
16	13.79	13.87	13.94	14.02	14.09	14.16	14.24	14.31	14.38	14.46	16	.07
17	14.53	14.60	14.68	14.75	14.82	14.89	14.97	15.04	15.11	15.18	17	.07
18	15.25	15.33	15.40	15.47	15.54	15.61	15.68	15.75	15.82	15.90	18	.07
19	15.97	16.04	16.11	16.18	16.25	16.32	16.39	16.46	16.53	16.60	19	.07

20	16.67	16.74	16.81	16.87	16.94	17.01	17.08	17.15	17.22	17.29	20	.07
21	17.36	17.42	17.49	17.56	17.63	17.70	17.76	17.83	17.90	17.97	21	.07
22	18.03	18.10	18.17	18.23	18.30	18.37	18.43	18.50	18.57	18.63	22	.07
23	18.70	18.76	18.83	18.90	18.96	19.03	19.09	19.16	19.22	19.29	23	.07
24	19.35	19.42	19.48	19.55	19.61	19.68	19.74	19.81	19.87	19.94	24	.06
25	20.00	20.06	20.13	20.19	20.26	20.32	20.38	20.45	20.51	20.57	25	.06
26	20.63	20.70	20.76	20.82	20.89	20.95	21.01	21.07	21.14	21.20	26	.06
27	21.26	21.32	21.38	21.45	21.51	21.57	21.63	21.69	21.75	21.81	27	.06
28	21.87	21.94	22.00	22.06	22.12	22.18	22.24	22.30	22.36	22.42	28	.06
29	22.48	22.54	22.60	22.66	22.72	22.78	22.84	22.90	22.96	23.02	29	.06
30	23.08	23.14	23.20	23.25	23.31	23.37	23.43	23.49	23.55	23.61	30	.06
31	23.66	23.72	23.78	23.84	23.90	23.95	24.01	24.07	24.13	24.18	31	.06
32	24.24	24.30	24.36	24.41	24.47	24.53	24.59	24.64	24.70	24.76	32	.06
33	24.81	24.87	24.92	24.98	25.04	25.09	25.15	25.21	25.26	25.32	33	.06
34	25.37	25.43	25.48	25.54	25.60	25.65	25.71	25.76	25.82	25.87	34	.06
35	25.93	25.98	26.04	26.09	26.14	25.20	26.25	26.31	26.36	26.42	35	.05
36	26.47	26.52	26.58	26.63	26.69	26.74	26.79	26.85	26.90	26.95	36	.05
37	27.01	27.06	27.11	27.17	27.22	27.27	27.33	27.38	27.43	27.48	37	.05
38	27.54	27.59	27.64	27.69	27.75	27.80	27.85	27.90	27.95	28.01	38	.05
39	28.06	28.11	28.16	28.21	28.26	28.32	28.37	28.42	28.47	28.52	39	.05
40	28.57	28.62	28.67	28.72	28.77	28.83	28.88	28.93	28.98	29.03	40	.05
41	29.08	29.13	29.18	29.23	29.28	29.33	29.38	29.43	29.48	29.53	41	.05
42	29.58	29.63	29.68	29.73	29.78	29.82	29.87	29.92	29.97	30.02	42	.05
43	30.07	30.12	30.17	30.22	30.26	30.31	30.36	30.41	30.46	30.51	43	.05
44	30.56	30.60	30.65	30.70	30.75	30.80	30.84	30.89	30.94	30.99	44	.05
45	31.03	31.08	31.13	31.18	31.22	31.27	31.32	31.37	31.41	31.46	45	.05
46	31.51	31.55	31.60	31.65	31.69	31.74	31.79	31.83	31.88	31.93	46	.05
47	31.97	32.02	32.07	32.11	32.16	32.20	32.25	32.30	32.34	32.39	47	.05
48	32.43	32.48	32.52	32.57	32.61	32.66	32.71	32.75	32.80	32.84	48	.05
49	32.89	32.93	32.98	33.02	33.07	33.11	33.16	33.20	33.24	33.29	49	.04
50	33.33	33.38	33.42	33.47	33.51	33.55	33.60	33.64	33.69	33.73	50	.04

PROPERTIES OF DRY AIR

Barometric Pressure 29.921 Inches

(From *Fan Engineering*, Buffalo Forge Co., Publishers, by permission)

Temperature, degrees Fahr.	Weight per cu. ft., pounds	Per cent of volume at 70°	B.t.u. absorbed by one cu. ft. dry air per degree F.	Cu. ft. dry air warmed one degree per B.t.u.	Temperature, degrees Fahr.	Weight per cu. ft., pounds	Per cent of volume at 70°	B.t.u. absorbed by one cu. ft. dry air per degree F.	Cu. ft. dry air warmed one degree per B.t.u.
0	.08636	.8680	.02080	48.08	130	.06732	1.1133	.01631	61.32
5	.08544	.8772	.02060	48.55	135	.06675	1.1230	.01618	61.81
10	.08453	.8867	.02039	49.05	140	.06620	1.1320	.01605	62.31
15	.08363	.8962	.02018	49.56	145	.06565	1.1417	.01592	62.82
20	.08276	.9057	.01998	50.05	150	.06510	1.1512	.01578	63.37
25	.08190	.9152	.01977	50.58	160	.06406	1.1700	.01554	64.35
30	.08107	.9246	.01957	51.10	170	.06304	1.1890	.01530	64.36
35	.08025	.9340	.01938	51.60	180	.06205	1.2080	.01506	66.40
40	.07945	.9434	.01919	52.11	190	.06110	1.2270	.01484	67.40
45	.07866	.9530	.01900	52.64	200	.06018	1.2455	.01462	68.41
50	.07788	.9624	.01881	53.17	220	.05840	1.2833	.01419	70.48
55	.07713	.9718	.01863	53.68	240	.05673	1.3212	.01380	72.46
60	.07640	.9811	.01846	54.18	260	.05516	1.3590	.01343	74.46
65	.07567	.9905	.01829	54.68	280	.05367	1.3967	.01308	76.46
70	.07495	1.0000	.01812	55.19	300	.05225	1.4345	.01274	78.50
75	.07424	1.0095	.01795	55.72	350	.04903	1.5288	.01197	83.55
80	.07356	1.0190	.01779	56.21	400	.04618	1.6230	.01130	88.50
85	.07289	1.0283	.01763	56.72	450	.04364	1.7177	.01070	93.46
90	.07222	1.0380	.01747	57.25	500	.04138	1.8113	.01018	98.24
95	.07157	1.0472	.01732	57.74	550	.03932	1.9060	.00967	103.42
100	.07093	1.0570	.01716	58.28	600	.03746	2.0010	.00923	108.35
105	.07030	1.0660	.01702	58.76	700	.03423	2.1900	.00847	118.07
110	.06968	1.0756	.01687	59.28	800	.03151	2.3785	.00782	127.88
115	.06908	1.0850	.01673	59.78	900	.02920	2.5670	.00728	137.37
120	.06848	1.0945	.01659	60.28	1000	.02720	2.7560	.00680	147.07
125	.06790	1.1040	.01645	60.79	1200	.02392	3.1335	.00603	165.83

PROPERTIES OF SATURATED AIR

Weights of Air, Vapor of Water, and Saturated Mixture of Air and Vapor at Different Temperatures, Under Standard Atmospheric Pressure of 29.921 Inches of Mercury

(From *Fan Engineering*, Buffalo Forge Co., Publishers, by permission)

Temperature, degrees Fahr.	Vapor pressure, inches of mercury	Weight in a cubic foot of mixture: Weight of the dry air, pounds	Weight in a cubic foot of mixture: Weight of the vapor, pounds	Weight in a cubic foot of mixture: Total weight of the mixture, pounds	B.t.u. absorbed by one cubic foot sat. air per degree F.	Cubic feet sat. air warmed one degree per B.t.u.
1	2	3	4	5	6	7
0	.0383	.08625	.000069	.08632	.02082	48.04
10	.0631	.08433	.000111	.08444	.02039	49.05
20	.1030	.08247	.000177	.08265	.01998	50.05
30	.1640	.08063	.000276	.08091	.01955	51.15
40	.2477	.07880	.000409	.07921	.01921	52.06
50	.3625	.07694	.000587	.07753	.01883	53.11
60	.5220	.07506	.000829	.07589	.01852	54.00
70	.7390	.07310	.001152	.07425	.01811	55.22
80	1.0290	.07095	.001576	.07253	.01788	55.93
90	1.4170	.06881	.002132	.07094	.01763	56.72
100	1.9260	.06637	.002848	.06922	.01737	57.57
110	2.5890	.06367	.003763	.06743	.01716	58.27
120	3.4380	.06062	.004914	.06553	.01696	58.96
130	4.5200	.05716	.006357	.06352	.01681	59.50
140	5.8800	.05319	.008140	.06133	.01669	59.92
150	7.5700	.04864	.010310	.05894	.01663	60.14
160	9.6500	.04341	.012956	.05673	.01664	60.10
170	12.2000	.03735	.016140	.05349	.01671	59.85
180	15.2900	.03035	.019940	.05029	.01682	59.45
190	19.0000	.02227	.024465	.04674	.01706	58.80
200	23.4700	.01297	.029780	.04275	.01750	57.15

WEIGHTS OF SATURATED AND PARTLY SATURAT HYGROMETRIC CONDITIONS—PO

(From *Fan Engineering*, Buffalo Forge

Dry bulb temperature, degrees Fahr.	Barometric pressure, inches								
	26			27			28		
	Wt. per cu. ft. saturated air	Decr's wt. per deg. inc. dry bulb	Incr's wt. per 0.1″ rise in bar	Wt. per cu. ft. saturated air	Decr's wt. per deg. inc. dry bulb	Incr's wt. per 0.1″ rise in bar	Wt. per cu. ft. saturated air	Decr's wt. per deg. inc. dry bulb	Incr's wt. per 0.1″ rise in bar
0	.07500	.00016	.00029	.07788	.00016	.00029	.08077	.00017	.00029
10	.07338	.00016	.00028	.07620	.00016	.00028	.07903	.00017	.00028
20	.07180	.00016	.00028	.07456	.00016	.00028	.07733	.00017	.00028
30	.07027	.00015	.00027	.07297	.00016	.00027	.07569	.00016	.00027
40	.06879	.00015	.00026	.07143	.00015	.00027	.07409	.00016	.00027
50	.06732	.00015	.00026	.06992	.00015	.00026	.07252	.00016	.00026
60	.06588	.00015	.00026	.06843	.00015	.00026	.07098	.00015	.00026
70	.06442	.00015	.00025	.06692	.00015	.00025	.06943	.00015	.00025
80	.06297	.00015	.00025	.06542	.00015	.00025	.06789	.00015	.00025
90	.06146	.00015	.00024	.06388	.00016	.00024	.06629	.00016	.00024
100	.05991	.00016	.00024	.06228	.00016	.00024	.06465	.00016	.00024
110	.05828	.00016	.00023	.06060	.00017	.00023	.06293	.00017	.00023
120	.05653	.00018	.00023	.05882	.00018	.00023	.06111	.00018	.00023
130	.05467	.00019	.00023	.05692	.00019	.00023	.05917	.00019	.00023
140	.05262	.00021	.00022	.05483	.00021	.00022	.05704	.00021	.00022
150	.05036	.00023	.00022	.05253	.00023	.00022	.05471	.00023	.00022
160	.04788	.00025	.00022	.05001	.00025	.00022	.05216	.00026	.00021
170	.04509	.00028	.00021	.04720	.00028	.00021	.04931	.00029	.00021
180	.04197	.00031	.00021	.04404	.00031	.00021	.04611	.00032	.00021
190	.03845	.00035	.00021	.04049	.00036	.00021	.04253	.00036	.00021
200	.03449	.00040	.00020	.03650	.00040	.00020	.03851	.00040	.00020

ED AIR FOR VARIOUS BAROMETRIC AND UNDS PER CUBIC FOOT

Co., Publishers, by permission)

Dry bulb temperature, degrees Fahr.	Barometric pressure, inches						
	29			30			
	Wt. per cu. ft. saturated air	Deer's wt. per deg. inc. dry bulb	Incr's wt. per 0.1" rise in bar	Wt. per cu. ft. saturated air	Deer's wt. per deg. inc. dry bulb	Incr's wt. per 0.1" rise in bar	Approx. aver'g increase in weight per degree wet bulb depression
0	.08365	.00018	.00029	.08654	.00019	.00029	.000015
10	.08185	.00018	.00029	.08468	.00018	.00028	.000016
20	.08009	.00018	.00028	.08268	.00018	.00028	.000017
30	.07839	.00017	.00027	.08110	.00017	.00027	.000019
40	.07675	.00016	.00027	.07942	.00017	.00027	.000021
50	.07512	.00016	.00026	.07773	.00016	.00026	.000023
60	.07353	.00016	.00026	.07609	.00016	.00026	.000026
70	.07193	.00016	.00025	.07440	.00016	.00025	.000029
80	.07034	.00015	.00025	.07280	.00016	.00025	.000034
90	.06870	.00016	.00024	.07112	.00017	.00024	.000039
100	.06703	.00017	.00024	.06939	.00018	.00024	.000044
110	.06526	.00018	.00023	.06759	.00019	.00023	.000051
120	.06339	.00019	.00023	.06569	.00020	.00023	.000059
130	.06142	.00020	.00023	.06367	.00022	.00023	.000068
140	.05925	.00022	.00022	.06147	.00024	.00022	.000078
150	.05689	.00024	.00022	.05906	.00026	.00022	.000090
160	.05430	.00026	.00021	.05644	.00029	.00021	.000103
170	.05141	.00031	.00021	.05352	.00033	.00021	.000118
180	.04818	.00034	.00021	.05026	.00036	.00021	.000134
190	.04457	.00037	.00021	.04662	.00038	.00021	.000153
200	.04052	.00041	.00020	.04254	.00041	.00020	.000173

CORRESPONDING PRESSURES AND VELOCITIES OF DRY AIR AT 70°F. AND 29.921 INCHES BAROMETER

(From *Fan Engineering*, Buffalo Forge Co., Publishers, by permission)

Inches of water	Ounces per sq. in.	Velocity, ft. per min.	Inches of water	Ounces per sq. in.	Velocity, ft. per min.
.05	.0289	896	5.00	2.884	8,943
.10	.0577	1,266	5.20	3.000	9,134
.20	.1154	1,791	5.50	3.172	9,392
.25	.1443	2,003	6.00	3.460	9.810
.30	.1730	2,193	6.07	3.500	9.864
.40	.2308	2,533	6.50	3.749	10,210
.43	.2500	2,637	6.94	4.000	10.545
.50	.2884	2,832	7.00	4.037	10,595
.60	.3460	3,102	7.50	4.326	10,968
.70	.4037	3,351	7.80	4.500	11,187
.75	.4326	3,468	8.00	4.614	11,328
.80	.4614	3,582	8.67	5.000	11,792
.87	.5000	3,729	9.00	5.190	12,015
.90	.5190	3,800	9.54	5.500	12,367
1.00	.5768	4,005	10.00	5.768	12,665
1.25	.7209	4,478	10.40	6.000	12,915
1.30	.7500	4,566	11.00	6.344	13,282
1.50	.8650	4,905	11.27	6.500	13,445
1.73	1.0000	5,273	12.00	6.921	13,875
1.75	1.0092	5,298	12.14	7.000	13,950
2.00	1.1535	5,664	13.00	7.497	14,440
2.17	1.2500	5,895	13.87	8.000	14.913
2.25	1.2975	6,007	14.00	8.074	14,985
2.50	1.4418	6,332	15.00	8.650	15,510
2.60	1.5000	6,457	15.61	9.000	15,820
2.75	1.5860	6,641	16.00	9.227	16.020
3.00	1.7300	6,937	17.00	9.805	16,513
3.03	1.7500	6,976	17.34	10.000	16,675
3.25	1.8740	7,220	18.00	10.380	16,990
3.47	2.0000	7,457	19.00	10.960	17,456
3.50	2.0185	7,492	19.07	11.000	17,488
3.75	2.1630	7,756	20.00	11.535	17,910
3.90	2.2500	7,910	20.81	12.000	18,265
4.00	2.3070	8,010	22.54	13.000	19,012
4.25	2.4510	8,256	24.28	14.000	19,730
4.34	2.5000	8,337	26.01	15.000	20,420
4.50	2.5950	8,496	27.74	16.000	21,090
4.75	2.7395	8,729			
4.77	2.750	8,745			

CORRESPONDING VELOCITIES FOR DRY AIR AT VARIOUS PRESSURES AND TEMPERATURES
29.92 INCHES BAROMETER

(From *Fan Engineering*, Buffalo Forge Co., Publishers, by permission)
Velocities in feet per minute

Pressure		Temperature, degrees Fahr.									
Inches	Ounces	50°	60°	70°	80°	100°	150°	200°	300°	500°	550°
.1	.0577	1,242	1,255	1,266	1,278	1,300	1,358	1,413	1,516	1,704	1,830
.2	.1154	1,757	1,776	1,791	1,808	1,841	1,921	2,000	2,145	2,411	2,590
.25	.1442	1,965	1,986	2,003	2,032	2,059	2,149	2,235	2,399	2,696	2,895
.3	.1730	2,151	2,175	2,193	2,214	2,254	2,352	2,447	2,626	2,952	3,175
.4	.2308	2,485	2,512	2,533	2,557	2,603	2,717	2,827	3,033	3,409	3,660
.5	.2884	2,778	2,808	2,832	2,859	2,911	3,038	3,160	3,391	3,812	4,095
.6	.3460	3,043	3,076	3,102	3,131	3,188	3,327	3,462	3,715	4,175	4,490
.7	.4037	3,287	3,323	3,351	3,383	3,445	3,595	3,740	4,013	4,510	4,850
.75	.4326	3,402	3,439	3,468	3,501	3,565	3,720	3,870	4,153	4,668	5,020
.8	.4614	3,524	3,552	3,582	3,616	3,682	3,843	3,997	4,290	4,821	5,185
.9	.5190	3,728	3,768	3,800	3,836	3,906	4,076	4,241	4,550	5,114	5,500
1.0	.5768	3,929	3,971	4,005	4,043	4,117	4,296	4,470	4,796	5,390	5,795
1.25	.7209	4,393	4,440	4,478	4,520	4,602	4,804	4,997	5,362	6,027	6,470
1.50	.8650	4,812	4,864	4,905	4,952	5,042	5,262	5,474	5,874	6,602	7,100
1.75	1.0092	5,197	5,254	5,298	5,348	5,446	5,683	5,912	6,344	7,131	7,655
2.00	1.1535	5,556	5,616	5,664	5,718	5,822	6,076	6,320	6,783	7,624	8,195
2.25	1.2975	5,892	5,956	6,007	6,064	6,174	6,443	6,704	7,193	8,085	8,690
2.50	1.4418	6,211	6,278	6,332	6,392	6,508	6,792	7,066	7,582	8,523	9,150
2.75	1.5860	6,514	6,585	6,641	6,704	6,827	7,124	7,412	7,952	8,938	9,600
3.00	1.7300	6,807	6,879	6,937	7,003	7,130	7,440	7,742	8,307	9,336	10,000
4.00	2.3070	7,857	7,942	8,010	8,086	8,233	8,592	8,940	9,581	10,780	11,580
5.00	2.8840	8,772	8,867	8,943	9,027	9,192	9,593	9,980	10,710	12,037	12,900
6.00	3.4600	9,623	9,728	9,810	9,903	10,083	10,523	10,950	11,750	13,203	14,180

CORRESPONDING VELOCITIES FOR DRY AIR AT VARIOUS PRESSURES AND TEMPERATURES
29.92 INCHES BAROMETER (Continued)

(From *Fan Engineering*, Buffalo Forge Co., Publishers, by permission)
Velocities in feet per minute

Pressure		Temperature, degrees Fahr.									
Ounces	Inches	50°	60°	70°	80°	100°	150°	200°	300°	500°	550°
.1	.1734	1,635	1,653	1,667	1,683	1,714	1,788	1,860	1,996	2,244	2,419
.2	.3468	2,313	2,338	2,358	2,380	2,424	2,530	2,632	2,824	3,174	3,405
.3	.5202	2,833	2,864	2,888	2,915	2,969	3,098	3,223	3,458	3,887	4,175
.4	.6936	3,272	3,307	3,335	3,367	3,428	3,578	3,722	3,994	4,489	4,850
.5	.8670	3,658	3,698	3,729	3,765	3,833	4,000	4,162	4,466	5,019	5,395
.6	1.0400	4,007	4,051	4,085	4,124	4,199	4,382	4,559	4,892	5,498	5,900
.7	1.2140	4,329	4,375	4,412	4,454	4,535	4,733	4,924	5,283	5,938	6,380
.8	1.3870	4,626	4,677	4,716	4,761	4,848	5,059	5,263	5,647	6,347	6,820
.9	1.5605	4,907	4,960	5,002	5,050	5,142	5,366	5,582	5,990	6,733	7,250
1.0	1.7340	5,172	5,229	5,273	5,323	5,420	5,656	5,884	6,314	7,098	7,625
1.1	1.9073	5,426	5,485	5,531	5,584	5,685	5,933	6,172	6,623	7,444	8,000
1.2	2.0808	5,664	5,725	5,774	5,828	5,935	6,194	6,443	6,914	7,772	8,350
1.3	2.2540	5,896	5,960	6,011	6,068	6,179	6,448	6,708	7,198	8,090	8,700
1.4	2.4275	6,120	6,186	6,238	6,297	6,412	6,692	6,962	7,470	8,396	9,020
1.5	2.6010	6,335	6,404	6,457	6,520	6,638	6,928	7,207	7,733	8,692	9,345
1.6	2.7742	6,543	6,614	6,670	6,734	6,856	7,155	7,444	7,987	8,977	9,650
1.8	3.1210	6,942	7,017	7,076	7,143	7,274	7,591	7,897	8,473	9,524	10,220
2.0	3.4680	7,315	7,395	7,457	7,528	7,665	8,000	8,322	8,930	10,037	10,780
2.2	3.8145	7,672	7,755	7,820	7,894	8,038	8,462	8,727	9,364	10,525	11,300
2.4	4.1615	8,012	8,099	8,168	8,245	8,296	8,762	9,115	9,781	10,995	11,800
2.6	4.5080	8,338	8,429	8,500	8,581	8,737	9,118	9,486	10,179	11,440	12,280
2.8	4.8550	8,654	8,748	8,822	8,906	9,068	9,464	9,845	10,564	11,873	12,750
3.0	5.2020	8,960	9,057	9,134	9,220	9,388	9,798	10,193	10,938	12,293	13,200

ALTITUDE-DENSITY TABLE FOR AIR

ALTITUDES IN FEET—STANDARD AIR AT 0 ALT. (29.92 IN. BAR.) = 1

(From *Fan Engineering*, Buffalo Forge Co., Publishers, by permission)

Alt.	Den.	Bar.	Alt.	Den.	Bar.
0	1.00	29.92	3000	.891	26.68
100	.966	29.81	3200	.885	26.48
200	.992	29.70	3400	.878	26.28
300	.989	29.58	3600	.872	26.08
400	.985	29.47	3800	.865	25.88
500	.981	29.36	4000	.858	25.68
600	.977	29.25	4200	.852	25.49
700	.974	29.14	4400	.846	25.30
800	.970	29.02	4600	.839	25.10
900	.966	28.91	4800	.833	24.91
1000	.962	28.80	5000	.826	24.72
1100	.959	28.69	5200	.820	24.53
1200	.955	28.58	5400	.814	24.35
1300	.952	28.47	5600	.808	24.16
1400	.948	28.36	5800	.802	23.98
1500	.944	28.26	6000	.795	23.79
1600	.941	28.15	6200	.789	23.61
1700	.937	28.04	6400	.784	23.43
1800	.933	27.93	6600	.778	23.26
1900	.930	27.83	6800	.772	23.08
2000	.926	27.72	7000	.766	22.90
2100	.923	27.62	7200	.760	22.73
2200	.919	27.51	7400	.754	22.56
2300	.916	27.41	7600	.748	22.38
2400	.912	27.30	7800	.743	22.21
2500	.909	27.20	8000	.737	22.04
2600	.905	27.09	8200	.731	21.87
1700	.902	26.99	8400	.726	21.70
2800	.898	26.89	8600	.720	21.54
2900	.895	26.78	8800	.714	21.37

TEMPERATURE-DENSITY TABLE FOR AIR

TEMP. IN DEG. FAHR. STANDARD AIR = 70° F. = 1

(From *Fan Engineering*, Buffalo Forge Co., Publishers, by permission)

Temp.	Dens.	Temp.	Dens.	Temp.	Dens.
−10	1.178	90	.964	300	.697
−5	1.165	92	.960	310	.688
0	1.152	94	.957	320	.680
5	1.140	96	.953	330	.671
10	1.128	98	.950	340	.662
15	1.116	100	.946	350	.654
20	1.104	105	.938	360	.646
25	1.093	110	.930	370	.638
30	1.082	115	.922	380	.631
35	1.071	120	.914	390	.624
40	1.060	125	.906	400	.616
42	1.056	120	.898	425	.599
44	1.052	135	.891	450	.582
46	1.047	140	.883	475	.567
48	1.043	145	.876	500	.552
50	1.039	150	.869	525	.538
52	1.035	155	.862	550	.525
54	1.031	160	.855	575	.512
56	1.027	165	.848	600	.500
58	1.023	170	.841	625	.488
60	1.019	175	.835	650	.477
62	1.015	180	.828	675	.467
64	1.011	185	.822	700	.457
66	1.008	190	.815	725	.447
68	1.004	195	.899	750	.438
70	1.000	200	.803	775	.429
72	.996	210	.791	800	.421
74	.992	220	.779	825	.412
76	.989	230	.768	850	.404
78	.985	240	.757	875	.397
80	.982	250	.747	...	....
82	.978	260	.736	...	....
84	.974	270	.726	...	....
86	.971	280	.716	...	....
88	.967	290	.707	...	....

EXAMPLES OF DEFORMATION EUTECTICS

From Wilson: *Ceramics, Clay Technology*, published by the McGraw-Hill Book Co., by permission

Author	Composition, per cent by weight	Fusion temperature, degrees Centigrade, or cone
Kirkpatrick.	Orthoclase 98.3, CaO 1.7	1261
Kirkpatrick.	Orthoclase 98.6, MgO 1.4	1271
Kirkpatrick.	Albite 84.3, CaO 15.7	1157
Kirkpatrick.	Albite 95.2–90.8, MgO 4.8–9.2	1185
Rieke	$Al_2O_3 2SiO_2$ 67.0, CaO 33.0	cone 7
Rieke	$Al_2O_3 1SiO_2$ 74.4, CaO 25.6	cone 10
Rieke	MgO 30, kaolin 30, quartz 40, or MgO 31, Al_2O_3 13, SiO_2 56	cone 10
Seger	Potash feldspar 42.1, whiting 17.7, hydrous kaolin 13.0, flint 27.2	cone 4
Watts	Albite 69, microcline 29.0	cone 6
Watts	Albite 100, quartz 0.0	cone 6–7
Watts	Microcline 90.0, quartz 10	cone 9 plus
Wilson	Potash feldspar 90.0, kaolin 10	cone 8 plus
Hanna	Canadian feldspar 92.0, Florida kaolin 8.0	cone 6–7
Hanna	Canadian feldspar 92.0, ball clay 8.0	cone 6 minus
Hanna	Canadian feldspar 96.0, quartz 4.0	cone 6–7
Hanna	CaO 23.25, Al_2O_3 14.75, SiO_2 62.0	cone 6 minus
Hanna	Feldspar 71.5, $CaCO_3$ 8.6, clay 7.7 flint 12.2	cone 3 minus
Watts	MgO 20.0, Al_2O_3 20.0, SiO_2 60.0	cone 12
Watts	BaO 35–40, Al_2O_3 10.0, SiO_2 55 to 50	cone 6
Watts	ZnO 50.0, Al_2O_3 20.0, SiO_2 30.0	cone 12–13
Watts	Canadian spar 59.62, whiting 8.03, zinc oxide 6.50, Florida kaolin 13.81, flint 12.04	cone 03
Mellor	PbO 88.0, SiO_2 12.0	532
Rice	K_2O 55, SiO_2 45	780
Rice	K_2O 17.5, SiO_2 82.5	880
Rice	K_2O 17.4, SiO_2 77.4, Al_2O_3 5.2	870[a]
Rice	Na_2O 51.5, SiO_2 48.5	830
Rice	Na_2O 18.4, SiO_2 81.6	860
Rice	Na_2O 17.5, SiO_2 77.1, Al_2O_3 5.4	800
Guertler	CaO 35, B_2O_3 65	995
Guertler	CaO 47.5, B_2O_3 52.5	1070
Guertler	BaO 76.5, B_2O_3 23.5	750
Klooster	$K_2O.B_2O_3$ 50, $Na_2O.B_2O_3$ 50	800
Wallace	$Na_2O.SiO_2$ 60, $BaO.SiO_2$ 40	.....
Eskola	$CaO.SiO_2$ 27.5, $BaO.SiO_2$ 72.5	.....
Lu	PbO 60.8, Al_2O_3 7.1, SiO_2 31.45	650
Lu	ZnO 50.8, Al_2O_3 14.45, SiO_2 35.75	1360
Lu	PbO 77.6, B_2O_3 6.1, SiO_2 16.3	415
Lu	Na_2O 24.2 B_2O_3 35.2, SiO_2 40.6	570
Lu	K_2O 23.7, B_2O_3 37.2, SiO_2 39.1	655

[a] Higher than binary eutectic.

HEATS OF FORMATION AND SOLUTION

The following table gives the heat of formation and heat of solution in small calories. To convert to British Thermal Units multiply the values by 0.003968.

The values are given for a temperature of about 15° C. unless otherwise stated. The heat of solution is given in most cases for a definite number of water molecules to one of the substance. Where this is not stated the dilution may be understood to be such that additional dilution produces a negligible thermal effect.

In the second column the formulæ indicate the substances entering the reaction or the nature of the compound where only the heat of solution is given.

(Compiled from various sources.)

Name.	Formula.	Physical state.	Heat of formation. Calories.	Water. mols.	Heat of solution. Calories.
Acetic Acid	C_2, H_4, O_2	liquid	117,200	200	+375
Aluminum					
bromide	Al, Br_3	solid	121,950	2970	+85,300[9°]
carbide	Al_4, C_3	solid	232,000	.....	.....
chloride	Al, Cl_3	solid	161,800	2500	+153,690
chloride	$AlCl_3$	.....	.....	1250	+76,845
fluoride	Al, F_3	dil. sol.	275,220	.....	.....
hydroxide	Al, O_3, H_3	solid	301,300	.....	.....
hydroxide	Al_2, O_3, $3H_2O$	solid	288,920	.....	.....
iodide	Al, I_3	solid	70,300	2250	+89,000[9°]
nitride	Al,N	solid	131,432	.....	.....
oxide [fate	Al_2O_3	solid	380,000	.....	.....
potassium sul-	$K_2Al_2(SO_4)_4.24H_2O$	.....	.....	2400	−20,240
silicate	Al_2, Si_2, O_7	solid	767,500	.....	.....
silicate	Al_2, Si_2, O_9, H_4	solid	927,420	.....	.....
sulfate	Al_2, S_3, O_{12}	dil. sol.	879,700	.....	.....
sulfide	Al_2, S_3	solid	126,400	.....	.....
Ammonia	N, H_3	gas	12,000	.....	.....
ammonia	N, H_3	liquid	21,000	.....	.....
Ammonium					
acetate	N, H_7, C_2, O_2	solid	150,250	200	+250[24°]
bromide	N, H_4, Br	solid	65,350	200	−4,380
bromide	NH_3, HBr	solid	45,500	.....	.....
carbonate	N_2, H_8, C, O_3, Aq	dil. sol.	221,600	.....	.....
carbonate, acid	N_2, H_5, C, O_3	solid	208,600	220–440	−6,300[3]
chloride	N, H_4, Cl	solid	76,800	200	−3,088[15°]
chloride	NH_3, HCl	solid	41,900	.....	.....
chloride	NH_4, Cl	.....	75,790	.....	.....
chloroplatinite	$(NH_4)_2PtCl_4$	.....	.....	660	−8,480
cyanate	N_2, H_4, C, O, Aq	dil. sol.	68,900	.....	.....
cyanide	N_2, H_4, C	solid	2,300	820	−4,400
cyanide	NH_3, HCN	solid	20,600	.....	.....
ferrocyanide	$(NH_4)_4Fe(CN)_6.3H_2O$	.....	.....	.....	−6,800[14°]
fluoride	N, H_4, F	solid	101,250	.....	−1,500
fluoride	NH_3, HF	solid	37,300	.....	.....
fluosilicate	N_2, H_8, Si, F_6	solid	458,950	2400	−8,400[7°]
hydroxide	N, H_5, O	.....	88,800	.....	.....
hydroxide	N, H_5, O, Aq	dil. sol.	90,000	.....	.....
iodide	N, H_4, I	solid	49,300	200	−3,550
iodide	NH_3, HI	solid	43,460	.....	.....
iodide	NH_4, I	solid	49,310	.....	.....
nitrate	N_2, H_4, O_3	solid	88,060	220–440	−6,200[15°]
				200	−6,320
nitrate	NH_3, HNO_3	.....	34,800	.....	.....
nitrite	N_2, H_4, O_2	.....	68,950	400	−4,750[12.5°]

HEATS OF FORMATION AND SOLUTION (Continued)

Name.	Formula.	Physical state.	Heat of formation. Calories.	Water mols.	Heat of solution. Calories.
Ammonium					
oxalate	N_2, H_8, C_2, O_4	solid	270,100	345–690	−8,000
oxalate	$(NH_4)_2C_2O_4.H_2O$	.....	.....	395–790	−11,500
phosphate	N_3, H_{12}, P, O_4, Aq	dil. sol.	403,000	.....	.....
" (di-basic)	N_2, H_9, P, O_4, Aq	dil. sol.	375,000	.....	.....
" (m.-bas.)	N, H_6, P, O_4, Aq	dil. sol.	341,200	.....	.....
sulphate	N_2, H_8, S, O_4	solid	283,500	400	−2,370
sulphate, acid	N, H_5, S, O_4	solid	244,600	200	−20
sulphate, per-	N_2, H_8, S_2, O_8	solid	392,900	1100	−9,700[2.4°]
sulphide	N_2, H_8, S	solid	66,200	.....	.....
sulphide, acid	N_2, H_5, S	solid	40,000	890	−3,250[12.5°]
sulphide, acid	NH_3, H_2S	solid	22,400	.....	.....
sulphite	N_2, H_8, S, O_3	solid	215,500	440	−1,540[8°]
sulphite	$(NH_4)_2SO_3.H_2O$	.....	.....	440	−5,360[10°]
sulphocyanate	N_2, H_4, C, S	solid	20,700	.....	−5,670[12°]
sulphydrate	NH_3, H_2S	solid	22,400	890	−3,250[13°]
sulphydrate	N, H_5, S	solid	40,000	.....	.....
Antimony					
acid (stibnic)	$3H_2O, Sb_2, O_5$	solid	228,780	.....	.....
acid (stibnous)	$3H_2O, Sb_2, O_3$	solid	167,420	.....	.....
bromide	Sb, Br_3	solid	61,400	.....	.....
chloride, tri-	Sb, Cl_3	solid	91,390	.....	+8,910
chloride, penta-	Sb, Cl_5	liquid	104,870	1100	+35,200
fluoride	Sb, F_3	solid	141,000	.....	.....
hydride (stibine)	Sb, H_3	gas const vol.	−34,270	.....	.....
hydride	Sb, H_3	const. press.	−33,960	.....	.....
iodide	Sb, I_3	solid	28,800	.....	.....
oxide, tri-	Sb_2, O_3	solid	166,900	.....	.....
oxide, penta-	Sb_2, O_5	solid	131,200	.....	.....
oxychloride	Sb_2, O_2, Cl_2	solid	179,600	.....	.....
sulphide	Sb_2, S_3	solid	34,400	.....	.....
Arsenic					
acid	H_3, As, O_4	solid	215,630	.....	−400
bromide	As, Br_3	solid	45,500	.....	.....
chloride	As, Cl_3	liquid	71,390	.....	.....
chloride	As, Cl_3	solid	−71,500	.....	.....
iodide	As, I_3	solid	13,500	.....	.....
hydride (arsine)	As (cryst.), H_3	gas	44,200	.....	.....
oxide, tri-	As_2, O_3	solid	154,670	.....	−7,550
oxide	As_2, O_3, Aq	dil. sol.	147,120	.....	.....
oxide	As_2(cryst.), O_3	solid	156,400	.....	−7,500
oxide, tri-	As_2(cryst.), O_3, Aq	dil. sol.	148,900	.....	.....
oxide, penta-	As_2, O_5	solid	219,380	.....	.....
oxide, penta-	As_2, O_5, Aq	dil. sol.	225,380	.....	.....
Aurichlorhydric Acid	$Au, Cl_4, H, 4H_2O$	solid	76,950	400	−5,830
Aurobromhydric Acid	Au, Br_4, H, Aq	dil. sol.	41,165	1000 ($5H_2O$)	−11,400
Barium					
acetate	$Ba(C_2H_3O_2)_2.3H_2O$	.....	.....	800	−1,150
acetate	Ba, C_4, H_6, O_4	solid	349,300	600	+5,200[10.2°]
arsenate	Ba_3, As_2, O_8 p'p't'd	solid	629,200	.....	.....
bromide	Ba, Br_2	solid	172,100	400	+4,980
bromide	$Ba, Br_2, 2H_2O$	solid	181,210	400	−4,130
carbonate	Ba, C, O_3	amorph.	282,500	.....	.....
carbonate	Ba, C, O_3	cryst.	283,000	.....	.....
carbonate	BaO, CO_2	solid	63,440	.....	.....
chlorate	Ba, Cl_2, O_6	solid	171,200	500–1000	−6,700[16°]
chlorate	$Ba(ClO_3).H_2O$	.....	.....	600	−11,240

HEATS OF FORMATION AND SOLUTION (Continued)

Name.	Formula.	Physical state.	Heat of formation. Calories.	Water mols.	Heat of solution Calories.
Barium					
chlorate	$Ba, Cl_2, O_6, 6H_2O$	solid	179,710	.....	.....
chlorate, per-	Ba, Cl_2, O_8	solid	201,400	550–1100	−1,800[10°]
chlorate, per-	$Ba, (ClO_4)_2, 3H_2O$	.....	.....	650–1300	−9,400
chloride	Ba, Cl_2	solid	196,880	400	+2,070
chloride	$Ba, Cl_2, 2H_2O$	solid	203,880	400	−4,930
cyanide	Ba, C_2, N_2	solid	48,300	.....	+1,800[9°]
cyanide	$Ba(CN)_2.2H_2O$	.....	.....	.....	−2,560[7°]
ferrocyanide	$Ba_2Fe(CN)_6.6H_2O$	.....	.....	.....	−11,400[14°]
fluoride	Ba, F_2	precip.	222,600	.....	−1,900
hydride	Ba, H_2	solid	37,500	.....	.....
hydroxide	Ba, O_2, H_2	solid	217,000	.....	+12,260
hydroxide	$Ba(OH)_2, 8H_2O$	.....	.....	400	−15,210
hypobromite	Ba, Br_2, O_2, Aq	dil. sol.	168,400	.....	.....
hypochlorite	Ba, Cl_2, O_2, Aq	dil. sol.	175,200	.....	.....
hypophosphite	Ba, H_4, P_2, O_4, Aq	dil. sol.	403,000	.....	.....
hypophosphite	$BaH_4(PO_2)_2, H_2O$	.....	.....	800	+290
iodide	Ba, I_2	solid	136,100	.....	+10,300[16°]
iodide	$Ba, I_2, 7H_2O$	solid	153,510	500	−6,850
nitrate	Ba, N_2, O_6	solid	228,400	400	−9,400
nitrate	$Ba(NO_3)_2.H_2O$	.....	.....	800	−8,600[12°]
nitride	Ba_3, N_2	solid	149,400	.....	.....
nitrite	Ba, N_2, O_4	solid	179,600	.....	.....
oxide	Ba, O	solid	126,380	.....	+34,520
oxide	$BaO.2H_2O$	.....	.....	666	+7,060
oxide, per-	Ba, O_2	solid	139,400	.....	.....
oxide, per-	BaO, O	solid	18,360	.....	.....
phosphate, tri-	Ba_3, P_2, O_8	cryst.	969,100	.....	.....
phosphate, di-	Ba, H, P, O_4	solid	424,600	.....	.....
phosphate, mono	Ba, H_4, P_2, O_8	solid	735,900	.....	.....
selenide	Ba, Se	solid	69,900	.....	.....
silicate	Ba, Si, O_3	solid	328,100	.....	.....
sulphate	Ba, S, O_4	solid	340,200	.....	−5,580
sulphide	Ba, S	solid	102,900	.....	+7,300
sulphide	Ba, S, Aq	dil. sol.	107,800	.....	.....
Beryllium					
chloride	Be, Cl_2	solid	155,000	.....	+44,500
sulphate	$BeSO_4.4H_2O$	.....	.....	400	+1,100
Bismuth					
chloride	Bi, Cl_3	solid	90,630	1600	+7,830[18°]
hydroxide	Bi, O_3, H_3	solid	171,700	.....	.....
hydroxide	$Bi_2, O_3, 3H_2O$	solid	137,740	.....	.....
oxide	Bi_2, O_3	solid	137,800	.....	.....
Boric Acid	$B_2O_3, 3H_2O$	solid	16,400	800	−10,790[18]
Boron					
bromide	B, Br_3	liquid	43,200	.....	.....
chloride	B, Cl_3	gas	89,100	.....	.....
chloride	B, Cl_3	liquid	93,400	.....	.....
fluoride	B, F_3	gas	234,800	.....	.....
oxide	B_2, O_3	solid	272,600	.....	+7,300
Bromic Acid	H, Br, O_3	dil. sol.	12,500	.....	.....
Bromine					
chloride	Br, Cl	liquid	700	.....	.....
Cadmium					
bromide	Cd, Br_2	solid	75,200	.....	.....
bromide	$Cd, Br_2, 4H_2O$	solid	82,930	.....	.....
carbonate	Cd, C, O_3	solid	181,890	.....	.....
chloride	Cd, Cl_2	solid	93,240	400	+3,010
chloride	$Cd, Cl_2, 2H_2O$	solid	98,530	400	+760
cyanide	Cd, C_2, N_2	solid	−35,200	.....	.....
cyanide	$Cd, 2CN$, Aq	dil. sol.	+33,960	.....	.....

HEATS OF FORMATION AND SOLUTION (Continued)

Name.	Formula.	Physical state.	Heat of formation. Calories.	Water mols.	Heat of solution. Calories.
Cadmium					
fluoride	CdF_2, Aq	dil. sol.	123,500	.....	.....
hydroxide	Cd, O, H_2O	solid	65,680	.....	.....
iodide	CdI_2	solid	48,330	400	−960
nitrate	Cd, N_2, O_6, H_2O	solid	113,300	400	+4,180
nitrate	$Cd, N_2, O_6, 4H_2O$	solid	121,160	400	−5,040
oxide	Cd, O	solid	66,300	.....	.....
selenide	Cd, Se	solid, cry.	14,300	.....	.....
selenide	Cd, Se	solid precip.	23,700	.....	.....
sulphate	Cd, SO_2, O_2	solid	150,470	400	+10,740
sulphate	Cd, S, O_4	solid	219,900	.....	.....
sulphate	$CdSO_4.H_2O$	.....	.....	400	+6,050
sulphate	$CdSO_4.\frac{8}{3}H_2O$	.....	.....	400	+2,660
sulphide	Cd, S, xH_2O	solid	34,350	.....	.....
telluride	Cd, Te	solid, cry.	16,600	.....	.....
Caesium					
bromide	Cs, Br	solid	47,700	.....	−3,250
carbonate	Cs_2O, CO_2	solid	97,530	.....	.....
carbonate	Cs_2, C, O_3	solid	274,540	.....	.....
carbonate, acid	Cs, H, C, O_3	solid	232,920	.....	.....
carbonate, acid	$CsOH, CO_2$	solid	11,250	.....	.....
chloride	Cs, Cl	solid	100,860	.....	−4,750[18°]
fluoride	Cs, F	solid	106,600	.....	+8,350
hydroxide	Cs, O, H	solid	101,300	330	+15,880
hydroxide	$CsOH.H_2O$	.....	.....	.....	+4,317
iodide	Cs, I	solid	83,600	.....	−1,450
oxide, mon-	Cs_2, O	solid	82,700	.....	+83,200
oxide, di-	Cs_2O, O	solid	28,260	.....	.....
oxide, tri-	Cs_2O_2, O	solid	18,000	.....	.....
oxide, tetr-	Cs_2O_2, O	solid	12,500	.....	.....
sulphate	Cs_2, S, O_4	solid	349,830	.....	−4,970
sulphate, acid	Cs, H, S, O_4	solid	282,900	.....	−3,730
Calcium					
acetate	Ca, C_4, H_6, O_4	solid	335,000	440	+7,000[15°]
acetate	$Ca(C_2H_3O_2)_2.H_2O$	.....	.....	600	+5,400[17°]
aluminate,					
" mono-	Ca, Al_2, O_4	solid	524,550	.....	.....
" di-	Ca_2, Al_2, O_5	solid	658,900	.....	.....
" tri-	Ca_3, Al_2, O_6	solid	789,050	.....	.....
aluminum silicate	Ca_3, Al_2, Si_2, O_{10}	solid	1,195,600	.....	.....
arsenate	Ca_3, As_2, O_8	solid	732,800	.....	.....
bromide	Ca, Br_2	solid	154,920	400	+24,510
bromide	$Ca, Br_2, 6H_2O$	solid	180,520	400	−1.090
carbide	Ca, C_2	solid	13,150	.....	.....
carbonate	Ca, C, O_3	solid precip.	269,100	.....	.....
carbonate	Ca, C, O_3	solid rhomb.	270,800	.....	.....
carbonate	CaO, CO_2	solid precip. (calcite)	43,300	.....	.....
carbonate	CaO, CO_2	solid	42,000	.....	.....
chloride	Ca, Cl_2	solid	190,400	300	+17,410
chloride	$Ca, Cl_2, 6H_2O$	solid	205,640	400	−4,055[18°]
cyanide	Ca, C_2, N_2, Aq	dil. sol.	38,300	.....	.....
ferrocyanide	$Ca_2Fe(CN)_6.12H_2O$	.....	.....	.....	−4,600[18°]
fluoride	Ca, F_2	solid precip.	218,400	.....	.....
fluoride	Ca, F_2	solid	239,200	.....	−2,700
hydride	Ca, H_2	solid	46,200	.....	.....
hydroxide	Ca, O, H$_2$C	solid	160,540	2500	+2,790

HEATS OF FORMATION AND SOLUTION (Continued)

Name.	Formula.	Physical state.	Heat of formation. Calories.	Water mols.	Heat of solution. Calories.
Calcium					
hydroxide	Ca, O_2, H_2	solid	236,000	.....	.....
iodide	Ca, I_2	solid	127,400	400	+27,690
nitrate	Ca, N_2, O_6	solid	216,770	400	+3,950
nitrate	$Ca(NO_3)_2.4H_2O$	.....	.....	400	−7,250
nitride	Ca_3, N_2	solid	112,200	.....	.....
nitrite	$H_2N_2O_2$, $Ca(OH)_2H_2O$	dil. sol.	21,600	.....	.....
oxalate	Ca, C_2, O_4	precip.	312,900	.....	.....
oxide	Ca, O	solid	151.900	2500	+18,330
oxide, per-	CaO, O	solid	5,400	.....	.....
oxide, per-	Ca, O_2	solid	156,010	.....	.....
phosphate	Ca_3, P_2, O_8	solid	919,200	.....	.....
silicate	Ca, Si, O_3	solid	344,400	.....	.....
silicate	CaO, SiO_2	solid	33,100	.....	.....
selenide	Ca, Se	solid	58,000	.....	.....
sulphate	Ca, SO_2, O_2	solid	261,360	.....	+2,920[9]
sulphate	$Ca, SO_2, O_2, 2H_2O$	solid (gypsum)	266,100	.....	−690[10]
sulphate	$CaSO_4.\frac{1}{2}H_2O$	.....	.....	.....	+3,560[10]
sulphate	$CaSO_4.4H_2O$	.....	.....	400	−7,970
sulphide	Ca, S	solid	112,200	.....	+6,310
sulphydrate	Ca, S_2, H_2, Aq	dil. sol.	125,300	.....	.....
Carbon					
chloride, di-	C_2, Cl_4	gas	−1,150	.....	.....
chloride, di-	C_2, Cl_4	liquid	+6,000	.....	.....
chloride, di-	C_2 (diamond), Cl_4	liquid	45,500	.....	.....
chloride, tri-	C_2 (diamond), Cl_6	solid	107,400	.....	.....
chloride, tetra-	C, Cl_4	gas	21,030	.....	.....
chloride, tetra-	C, Cl_4	liquid	28,200	.....	.....
chloride, tetra-	C (diamond), Cl_4	gas	68,500	.....	.....
chloride, tetra-	C (diamond), Cl_4	liquid	75,700	.....	.....
oxide, mon-	C, O	gas	29,000	.....	.....
oxide, mon-	C (diamond), O	gas	26,100	.....	.....
oxide, di-	C, O_2	gas	97,000	.....	.....
oxide, di-	C (diamond), O_2	gas	94,310	.....	.....
oxychloride	C, O, Cl_2	gas	44,000	.....	.....
oxysulphide	C, O, S	solid	37,030	.....	.....
sulphide, di-	C, S_2	gas	−25,400	.....	.....
sulphide, di-	C, S_2	liquid	−19,000	.....	.....
Cerium					
oxide	Ce, O_2	solid	+224,600	.....	.....
Chloric acid	Cl, O_3, H, Aq	dil. sol.	22,000	.....	.....
Chlorine					
oxide, mon-	Cl_2, O	gas	−17,930	.....	.....
Chlorosulphonic acid	S, O_3, H, Cl	gas	+127,400	.....	.....
acid	S, O_3, H, Cl	liquid	140,200	.....	.....
Chromium					
bromide (ic)	$CrBr_3.6H_2O$	green	.....	.....	+700
bromide (ic)	$CrBr_3.6H_2O$	blue	.....	.....	+14,350
chloride (ic)	$CrCl_2$, Aq, Cl	dil. sol. violet	56,700	.....	.....
chloride (ic)	$CrCl_3$	.....	.....	.....	+35,900
chloride (ic)	$2CrCl_3.13H_2O$	green	.....	....	−100
chloride (ic)	$2CrCl_3.13H_2O$	gray	.....	.....	+24,040
chloride (ous)	$CrCl_2$	.....	.....	.....	+18,600
chloride (ous)	$CrCl_2.4H_2O$	.....	.....	.....	+2,000
oxide (ic)	Cr_2, O_3	cryst.	267,800	.....	.....
oxide (ic)	Cr_2, O_3	amorph.	243,800	.....	.....
oxide, tri-	Cr, O_3	solid	140,000	220	+1,900[10]

HEATS OF FORMATION AND SOLUTION (Continued)

Name.	Formula.	Physical state.	Heat of formation. Calories.	Water mols.	Heat of solution. Calories.
Chromium					
sulphate (ic)	$Cr_2(SO_4)_3.8H_2O$	green	.....	.....	+13,600
sulphate (ic)	$Cr_2(SO_4)_3.16H_2O$	violet	.....	.....	+6,200
Cobalt					
bromide (ous)	Co, Br_2, Aq	dil. sol.	72,940	.....	.....
chloride (ous)	Co, Cl_2	solid	76,700	400	+18,340
chloride (ous)	$CoCl_2.6H_2O$	.....	.....	400	−2,850
fluoride (ous)	Co, F_2, Aq	dil. sol.	122,200	.....	.....
hydroxide (ic)	$Co_2, O_3, 3H_2O$	solid	149,380	.....	.....
hydroxide (ic)	$2Co(OH)_2, O, H_2O$	solid	22,580	.....	.....
hydroxide (ous)	Co, O, H_2O	solid	63,400	.....	.....
iodide (ous)	Co, I_2, Aq	dil. sol.	40,700	.....	.....
nitrate (ous)	CoO, N_2O_5, Aq	dil. sol.	84,540	.....	.....
nitrate (ous)	$Co, N_2, O_6, 6H_2O$	solid	120,680	400	−4,960
oxide (ous)	Co, O	cryst.	57,500	.....	.....
oxide (ous)	Co, O	amorph.	57,500	.....	.....
oxide (ous, ic)	Co_3, O_4	solid	193,400	.....	.....
selenide (ous)	Co, Se	cryst.	9,900	.....	.....
selenide (ous)	Co, Se	precip.	13,900	.....	.....
sulphate (ous)	Co, O, SO_3, Aq	dil. sol.	88,070	.....	.....
sulphate (ous)	$Co, O_2, SO_2, 7H_2O$	solid	164,970	800	−3,570
sulphide (ous)	Co, S, xH_2O	solid	19,730	.....	.....
telluride (ous)	Co, Te	solid	13,000	.....	.....
Copper					
acetate (ic)	Cu, C_4, H_6, O_4	solid	213,900	320	+2,400[16°]
acetate (ic)	$Cu(C_2H_3O_2)_2.H_2O$	.....	.....	440	+800[16°]
bromide (ic)	Cu, Br_2	solid	32,600	400	+8,250
bromide (ic)	$CuBr_2.4H_2O$	.....	.....	.....	−1,500[8°]
bromide (ous)	Cu, Br	solid	24,980	.....	.....
carbonate (ic)	Cu, C, O_3	precip.	142,800	.....	.....
chlorate (ic)	Cu, Cl_2, O_6, Aq	dil. sol.	28,600	.....	.....
choride (ic)	Cu, Cl_2	solid	51,400	600	+11,800
chloride (ic)	$Cu, Cl_2, 2H_2O$	solid	58,500	400	+4,210
chloride (ous)	Cu, Cl	solid	35,400	.....	.....
cyanide (ous)	Cu, C, N	solid	−22,050	.....	.....
fluoride (ic)	Cu, F_2, Aq	dil. sol.	+89,600	.....	.....
iodide (ous)	Cu, I	solid	16,260	.....	.....
nitrate (ic)	$Cu, N_2, O_6, 6H_2O$	solid	92,940	400	−10,710
oxide (ic)	Cu, O	solid	37,700	.....	.....
oxide (ic)	Cu_2O, O	solid	36,200	.....	.....
oxide (ous)	Cu_2, O	solid	43,800	.....	.....
selenide (ic)	Cu, Se	precip.	4,800	.....	.....
selenide (ous)	Cu_2, Se	cryst.	8,000	.....	.....
sulphate (ic)	Cu, O_2, SO_2	solid	111,490	400	+15,800
sulphate (ic)	Cu, O_2, SO_2, H_2O	solid	117,950	400	+9,340
sulphate (ic)	$Cu, O_2, SO_2, 5H_2O$	solid	130,040	400	−2,750
sulphate (ic)	Cu, S, O_4	solid	181,700	.....	.....
sulphide (ic)	Cu, S	solid	10,100	.....	.....
sulphide (ous)	Cu_2, S	solid	20,300	.....	.....
telluride	Cu_2, Te	solid	8,200	.....	.....
Cyanic acid	C (diam.), N, O, H, Aq	dil. sol.	74,000	.....	.....
Cyanogen	C_2, N_2	gas	−65,700	.....	.....
cyanogen	C_2 (diamond), N_2	gas	−73,900	.....	.....
cyanogen	C_2 (diamond), N_2	liquid	+68,500	.....	.....
chloride	C (diamond), N, Cl	gas	35,200	.....	.....
chloride	C (diamond), N, Cl	liquid	−26,800	.....	.....
iodide	C (diamond), N, I	solid	−39,200	.....	−2,800
Dysprosium					
sulphate	$Dy_2(SO_4)_3.8H_2O$	.....	.....	1200	+6,300
Erbium acetate	$Er(C_2H_3O_2)_3.4H_2O$	.....	.....	1500	+700

HEATS OF FORMATION AND SOLUTION (Continued)

Name.	Formula.	Physical state.	Heat of formation. Calories.	Water mols.	Heat of solution. Calories.
Ferric and Ferrous salts, see under Iron					
Fluosilicic acid	Si, F_6, H_2, Aq	dil. sol.	374,400	.....	.....
Glucinum (Beryllium) chloride	Gl, Cl_2	solid	155,000	.....	+44,500
sulphate	$GlSO_4.4H_2O$	.....	.....	400	+ 1,100
Gold bromide (ic)	Au, Br_3	solid	8,850	2000	− 3,760
bromide (ous)	Au, Br	solid	−80	.....	.....
chloride (ic)	Au, Cl_3	solid	+22,820	900	+ 4,450
chloride (ic)	$AuCl_3.2H_2O$	.....	.....	600	− 1,690
chloride (ous)	Au, Cl	solid	5,810	.....	.....
hydroxide (ic)	$Au_2, O_3, 3H_2O$	solid	−13,190	.....	.....
iodide (ous)	Au, I	solid	−5,520	.....	.....
Hydrazine	N_2, H_4, Aq	dil. sol.	+1,700	.....	.....
Hydrazoic acid	N_3, H, Aq	dil. sol.	58,200	.....	.....
Hydrobromic acid	H, Br	gas	8,600	.....	+20,000
Hydrochloric acid	H, Cl	gas	22,000	.....	+17,400
Hydrocyanic acid	C (diamond), N, H	gas	−30,500	.....	.....
" "	C (diamond), N, H	liquid	−24,800	.....	.....
" "	C (diamond), N, H	dil. sol.	−24,400	.....	.....
Hydroferricyanic acid	H_3, Fe, C_6N_6, Aq	dil. sol.	−127,500	.....	.....
acid	H_3, Fe, C_6, N_6, Aq	dil. sol.	−147,500	.....	.....
Hydroferrocyanic acid	H_4, Fe, C_6, N_6	solid	−102,000	.....	+500
acid	H_4, Fe, C_6, N_6	solid	−122,000	.....	.....
Hydrofluoric acid	H, F	gas	+38,500	.....	.....
" "	H, F	liquid	45,700	.....	.....
" "	H, F	dil. sol.	50,300	.....	.....
Hydr(o)iodic acid	H, I	gas	−6,400	.....	+19,600
Hydrogen oxide (water)	H_2, O	liquid	+69,000°	.....	.....
oxide	H_2, O	solid	70,400°	.....	.....
oxide	H_2, O	gas	58,300°	.....	.....
peroxide	H_2, O_2, Aq	dil. sol.	45,300	.....	.....
peroxide	H_2O, O, Aq	dil. sol.	−23,060	.....	.....
peroxide	H_2, O_2	liquid	+40,840	.....	.....
selenide	H_2, Se	gas	−19,400	.....	+ 9,300
sulphide	H_2, S	gas	+2,730	.....	+ 4,560
telluride	H_2, Te	gas	−34,900	.....	.....
Hydrosulphurous acid	S_2, O_4, H_2, Aq	dil. sol.	+156,100	.....	.....
Hydroxylamine	N, H_3, O, Aq	dil. sol.	24,290	.....	.....
"	N, H_3, O	solid	27,600	.....	− 2,800
Iodic acid	I, O_3, H	solid	57,960	.....	- 2,160
Iodine bromide	I, Br	solid	2,500	.....	.....
chloride, mono-	I, Cl	solid	6,800	.....	.....
chloride, mono-	I, Cl	liquid	5,820	.....	.....
chloride, tri-	I, Cl_3	solid	21,490	.....	.....
oxide, pent-	I_2, O_5	solid	45,030	.....	− 1,790
Iron acetate (ic)	Fe, C_6, H_9, O_6, Aq	dil. sol.	359,350	.....	.....
ammonium sulphate (ic)	$(NH_4)Fe(SO_4)_2. 12H_2O$	.....	.....	500	−16,600
ammonium sulphate (ous)	$(NH_4)_2Fe(SO_4)_2. 6H_2O$	.....	.....	.....	− 9,800
bromide (ic)	Fe, Br_3, Aq	dil. sol.	95,450	.....	.....

HEATS OF FORMATION AND SOLUTION (Continued)

Name.	Formula.	Physical state.	Heat of formation. Calories.	Water mols.	Heat of solution. Calories.
Iron					
bromide (ous)	Fe, Br_2, Aq	dil. sol.	78,070	.....	.....
carbonate (ous)	Fe, C, O_3	cryst.	184,500	.....	.....
carbonate	Fe, C, O_3	precip.	178,800	.....	.....
carbonate	FeO, CO_2	solid	24,500	.....	.....
chloride (ic)	Fe, Cl_3	solid	96,040	1000	+32,680
chloride (ic)	$FeCl_2, Cl$	solid	13,990	.....	.....
chloride (ic)	$2FeCl_3.5H_2O$	.....	.....	2400	⌟ 2×21,000
chloride (ic)	$FeCl_3.6H_2O$	.....	.....	1200	+ 5,650
chloride (ous)	Fe, Cl_2	solid	82,200	350	+17,850
chloride (ous)	$FeCl_2.2H_2O$	.....	.....	1000	+ 9,700[20°]
chloride ous	$FeCl_2.4H_2O$	.....	.....	400	+ 2,750
ferrocyanide (ic)	Fe_7, C_{18}, N_{18}	precip.	−317,000	.....	.....
fluoride (ic)	Fe, F_3, Aq	dil. sol.	+162,900	.....	.....
fluoride (ous)	Fe, F_2, Aq	dil. sol.	127,000	.....	.....
hydroxide (ic)	$Fe_2, O_3, 3H_2O$	solid	2×95,570	.....	.....
hydroxide (ic)	$2Fe(OH)_2, O, H_2O$	solid	2×27,290	.....	.....
hydroxide (ous)	Fe, O, H_2O	solid	68,280	.....	.....
iodide (ic)	Fe, I_3, Aq	dil. sol.	23,850	.....	.....
iodide (ous)	Fe, I_2, Aq	dil. sol.	47,650	.....	.....
nitrate (ic)	Fe, N_3, O_9, Aq	dil. sol.	314,300	.....	.....
nitrate (ous)	Fe, N_2, O_6, Aq	dil. sol.	119,000	.....	.....
oxide (ic)	Fe_2, O_3	solid	197,700	.....	.....
oxide (ous)	Fe, O	solid	65,700	.....	.....
oxide (ous, ic)	Fe_3, O_4	solid	270,800	.....	.....
pot. sul. (ic)	$KFe(SO_4)_2.12H_2O$	.....	.....	500	−16,000
pot. sul. (ous)	$K_2Fe(SO_4)_2.6H_2O$	.....	.....	.....	−10,700
selenide (ous)	Fe, Se	cryst.	16,000	.....	.....
selenide (ous)	Fe, Se	precip.	15,200	.....	.....
silicate	Fe, Si, O_3	solid	254,600	.....	.....
sulphate (ic)	Fe_2, S_3, O_{12}, Aq	dil. sol.	650,500	.....	.....
sulphate (ic)	$Fe_2, O_3, 3SO_3, Aq$	dil. sol.	224,900	.....	.....
sulphate (ous)	Fe, SO_2, O_2, Aq	dil. sol.	93,200	.....	.....
sulphate (ous)	$Fe, SO_2, O_2, 7H_2O$	solid	169,040	400	− 4,510
sulphate (ous)	Fe, S, O_4, Aq	dil. sol.	234,900	.....	.....
sulphide (ous)	Fe, S, xH_2O	solid	24,000	.....	.....
telluride (ous)	Fe, Te	cryst.	12,000	.....	.....
Lanthanum					
chloride	La, Cl_2	solid	175,300	.....	.....
oxide	La_2, O_3	solid	447,300	.....	.....
Lead					
acetate	Pb, C_4, H_6, O_4	solid	231,100	440	+ 1,400[16°]
acetate	$Pb(C_2H_3O_2)_2.3H_2O$	.....	.....	800	− 6,140
acetate	$Pb(C_2H_3O_2)_2.3H_2O$	.....	.....	240	− 5,500[11°]
bromide	Pb, Br_2	solid	64,450	25,000	−10,040
carbonate	Pb, C, O_3	solid	166,700	.....	.....
chloride	Pb, Cl_2	solid	83,900	1800	− 6,800
dithionate	$PbS_2O_6.4H_2O$	.....	.....	400	− 8,540
fluoride	Pb, F_2	precip.	107,600	.....	.....
iodide	Pb, I_2	solid	39,800	.....	.....
nitrate	Pb, N_2, O_6	solid	105,460	400	− 7,610
oxalate	Pb, C_2, O_4	precip.	205,300	.....	.....
oxide, mon-	Pb, O	solid	50,300	.....	.....
oxide, per-	PbO, O	solid	12,600	.....	.....
oxide, per-	Pb, O_2	solid	62,400	.....	.....
oxybromide	$PbBr_2, PbO$	solid	3,300	.....	.....
oxybromide	$PbBr_2, 2PbO$	solid	4,700	.....	.....
oxybromide	$PbBr_2, 3PbO$	solid	6,300	.....	.....
oxychloride	$PbCl_2, PbO$	solid	5,300	.....	.....
oxychloride	$PbCl_2, 2PbO$	solid	6,600	.....	.....
oxychloride	$PbCl_2, 3PbO$	solid	6,700	.....	.....

HEATS OF FORMATION AND SOLUTION (Continued)

Name.	Formula.	Physical state.	Heat of formation. Calories.	Water mols.	Heat of solution. Calories.
Lead					
oxyiodide	PbI_2, PbO	solid	3,600	.....	.....
phosphite	Pb, H, P, O_3	solid	227,700	.....	.....
selenide	Pb, Se	precip.	14,300	.....	.....
selenide	Pb, Se	cryst.	17,000	.....	.....
sulphate	Pb, S, O_4	solid	216,210	.....	.....
sulphate	Pb, SO_2, O_2	solid	145,130	.....	.....
sulphide	Pb, S	precip.	20,300	.....	.....
sulphocyanate	Pb, C_2, N_2, S_2	solid	6,100	.....	.....
telluride	Pb, Te	solid	6,200	.....	.....
thiosulphate	Pb, S_2, O_3	solid	145,600	.....	.....
Lithium					
bromide	Li, Br	solid	79,960	.....	+11,331
carbide	Li_2, C_2	solid	11,300	.....	.....
carbonate	$LiO_2 (CO_2)$	solid	54,230	.....	.....
chloride	Li, Cl	solid	93,310	230	+ 8,440
cyanide	Li, C, N, Aq	dil. sol.	32,600	.....	.....
fluoride	Li, F	solid	120,000	.....	− 3,120
fluosilicate	$2LiF, SiF_4$	solid	25,200	800	+ 1,800
hydride	Li, H	solid	21,600	.....	.....
hydroxide	Li, O, H	solid	112,300	400	+ 5,800
hydroxide	$LiOH.H_2O$	.....	.....	.....	$+510^{18°}$
iodide	Li, I	solid	61,210	.....	+14,886
nitrate	Li, N, O_3	solid	111,610	100	+300
nitride	Li_6, N_2	solid	93,500	.....	.....
oxide	Li_2, O	solid	143,300	222	$+31,200^{15°}$
oxide	$4Li_2O, 5H_2O$	.....	.....	888	$+8,182^{15°}$
oxide	$4Li_2O, 3H_2O$	.....	.....	888	$+16,026^{15°}$
selenide	Li_2, Se	solid	83,000	.....	$+10,700^{20°}$
selenide	$Li_2Se.9H_2O$	.....	.....	1146–6426	−12,200
silicate	Li_2, Si, O_3	solid	347,100	.....	.....
sulphate	Li_2, S, O_4	solid	334,170	200	+ 6,050
sulphate	Li_2, S, O_4, H_2O	solid	336,810	400	+ 3,410
sulphide	Li_2, S, Aq	dil. sol.	115,400	.....	.....
sulphydrate	Li, S, H, Aq	dil. sol.	64,110	.....	.....
Magnesium					
ammonium phosphate	Mg, N, H_4, P, O_4	cryst.	898,800	.....	.....
sulphate	$MgSO_4 (NH_4)_2SO_4. 6H_2O$	.....	.....	.....	− 9,700
sulphite	$3(MgSO_3.6H_2O), (NH_4)_2SO_3$	solid	−2,100	.....	.....
arsenate	Mg_3, As_2, O_4	cryst.	+712,600	.....	.....
bromide	Mg, Br_2	solid	121,700	.....	+43,300
carbonate	Mg, C, O_3	precip.	266,600	.....	.....
chloride	Mg, Cl_2	solid	151,010	800	+35,920
chloride	$Mg, Cl_2, 6H_2O$	solid	183,980	400	+ 2,950
cyanide	Mg, C_2, N_2, Aq	dil. sol.	34,000	.....	.....
dithionate	$Mg, S_2, O_6, 6H_2O$	solid	390,570	400	+ 2,960
fluoride	Mg, F_2	precip.	208,100	.....	+ 2,778
hydroxide	Mg, O_2, H_2	solid	217,800	.....	.....
iodide	Mg, I_2	solid	84,800	.....	49,890
nitrate	$Mg, N_2, O_6, 6H_2O$	solid	210,520	400	− 4,220
oxide	Mg, O	solid	143,900	.....	.....
phosphate	Mg_3, P_2, O_8	colloid	910,600	.....	.....
pot. chloride	$MgCl_2, KCl$	solid	3,100	.....	.....
pot. chloride	$MgCl_2, 6H_2O, KCl$	solid	2,700	.....	.....
pot. sulphate	$MgSO_4, K_2SO_4$	solid	3,300	600	+10,600
pot. sulphate	$MgSO_4, K_2SO_4, 6H_2O$	solid	23,920	600	−10,020
sodium sulphate	$MgSO_4, Na_2SO_4$	solid	3,700	.....	.....

HEATS OF FORMATION AND SOLUTION (Continued)

Name.	Formula.	Physical state.	Heat of formation. Calories.	Water mols.	Heat of solution. Calories.
Magnesium					
sulphate	Mg, S, O_4	solid	301,500	400	+20,280
sulphate	$MgSO_4.H_2O$	.....	.....	400	+13,300
sulphate	$MgSO_4.7H_2O$	.....	.....	400	− 3,800
sulphide	Mg, S	solid	79,400	.....	.....
sulphite	Mg, S, O_3	solid	282,000	.....	.....
sulphydrate	Mg, S_2, H_2, Aq	dil. sol.	110,860	.....	.....
Manganese					
bromide	Mn, Br_2, Aq	dil. sol.	107,000	.....	.....
carbide	Mn_3, C	solid	9,900	.....	.....
carbonate	Mn, C, O_3	amorp.	207,000	.....	.....
carbonate	Mn, C, O	crystal	208,600	.....	.....
carbonate	MnO, CO_2	solid	27,000	.....	.....
chloride	Mn, Cl_2	solid	111,990	350	+16,010
chloride	$Mn, Cl_2, 4H_2O$	solid	126,460	400	+ 1,540
dithionate	$Mn, 2SO_2, O_2, 6H_2O$	solid	188,600	400	+ 1,930
fluoride	Mn, F_2, Aq	dil. sol.	156,800	.....	.....
fluoride	Mn, F_2	solid	209,500	.....	.....
hydroxide	Mn, O, H_2O	solid	94,770	.....	.....
iodide	Mn, I_2, Aq	dil. sol.	76,200	.....	.....
nitrate	$Mn, N_2, O_6, 6H_2O$	solid	153,050	400	− 6,150
oxide (ous)	Mn, O	solid	90,800	.....	.....
oxide (di-)	Mn, O_2	solid	126,000	.....	.....
oxide (ous, ic)	Mn_3, O_4	solid	324,900	.....	.....
phosphate	Mn_3, P_2, O_8	colloid	737,500	.....	.....
pot. sulphate	$MnSO_4, K_2SO_4$	solid	990	600	+ 6,330
pot. sulphate	$MnSO_4, K_2SO_4, 4H_2O$	solid	13,846	600	− 6,440
selenide	Mn, Se	precip.	22,400	.....	.....
selenide	Mn, Se	cryst.	21,600	.....	.....
silicate	MnO, SiO_2	solid	5,400	.....	.....
sodium sulphate	$MnSO_4, Na_2SO_4$	solid	1,200	.....	− 9,700
sulphate	Mn, SO_2, O_2	solid	249,400	400	+13,790
sulphate	Mn, SO_2, O_2, H_2O	solid	184,760	400	+ 7,820
sulphate	$Mn, SO_2, O_2, 5H_2O$	solid	192,540	400	+40
sulphide	Mn, S, xH_2O	solid	45,600	.....	.....
Mercury					
acetate (ic)	Hg, C_4, H_6, O_4	solid	196,900	222	− 3,800
acetate (ous)	Hg, C_2, H, O_2	solid	101,050	.....	.....
bromide (ic)	Hg, Br_2	solid	40,600	.....	− 3,400[12°]
bromide (ous)	Hg, Br	solid	24,500	.....	.....
chloride (ic)	Hg, Cl_2	solid	53,300	300	− 3,300
chloride (ous)	Hg, Cl	solid	31,300	.....	.....
cyanide (ic)	$Hg, (CN)_2$	solid	11,400	1010	− 3,000[15°]
fulminate	Hg, N_2, C_2, O_2	solid	−62,900	.....	.....
iodide (ic)	Hg, I_2	solid	+25,200	.....	.....
iodide (ous)	Hg, I	solid	14,300	.....	.....
nitrate (ic)	Hg, N_2, O_6, Aq	dil. sol.	57,400	.....	.....
nitrate (ic)	$Hg, N_2, O_6, \frac{1}{2} H_2O$	solid	57,400	.....	.....
nitrate (ous)	Hg, N, O_3, H_2O	solid	34,700	.....	.....
nitrate (ous)	Hg, N, O_3, Aq	dil. sol.	28,900	.....	.....
nitride, tri-(ous)	Hg, N_3	solid	−144,600	.....	.....
oxide (ic)	Hg, O	solid	+21,500	.....	.....
oxide (ous)	Hg_2, O	solid	2,200	.....	.....
oxybromide (ic)	$HgBr_2, HgO$	solid	3,300	.....	.....
oxychloride (ic)	$HgCl_2, HgO$	solid	3,300	.....	.....
oxychloride	$HgCl_2, 2HgO$	solid	6,300	.....	.....
oxychloride	$HgCl_2, 3HgO$	solid	8,000	.....	.....
oxychloride	$HgCl_2, 4HgO$	solid	10,000	.....	.....
potassium bromide (ic)	$HgBr_2, KBr$	solid	−1,000	.....	.....
potassium bromide (ic)	$HgBr_2, 2KBr$	.....	.....	600	−9,750

HEATS OF FORMATION AND SOLUTION (Continued)

Name.	Formula.	Physical state.	Heat of formation. Calories.	Water mols.	Heat of solution. Calories.
Mercury					
potassium chloride (ic)	$HgCl_2$, KCl	solid	2,400	770	− 9,500[14a]
pot. chlo. (ic)	$HgCl_2$, 2KCl	solid	3,800	930	−15,000[14c]
pot. chlo. (ic)	Hg, Cl_2, 2KCl, H_2O	solid	60,620	600	−16,390
pot. iodide (ic)	HgI_2, 2KI	solid	28,680	800	− 9,810
selenide (ic)	Hg, Se	precip.	6,300		
sulphate (ic)	Hg, S, O_4	solid	165,100		
sulphate (ous)	Hg_2, S, O_4	solid	175,000		
sulphide	Hg, S	precip.	10,600		
sulphocyanate	Hg, C_2, N_2, S_2	solid	−50,200		
Molybdenum					
oxide, di-	Mo, O_2	solid	+142,800		
oxide, tri-	Mo, O_3	solid	167,000		
Neodymium					
chloride	Nd, Cl_3	solid	249,500		+35,400[17c]
chloride	Nd, Cl_3, $6H_2O$	solid	268,900		+ 7,600[15c]
iodide	Nd, I_3	solid	157,700		+48,900[19c]
oxide	Nd_2, O_3	solid	435,100		
sulphate	Nd_2, S_3, $6O_2$	solid	928,200		+36,500[14]
sulphide	Nd_2, S_3	solid	285,900		
Nickel					
bromide	Ni, Br_2, Aq	dil. sol.	71,820		
chloride	Ni, Cl_2	solid	74,530	400	+19,170
chloride	$NiCl_2$, $6H_2O$	solid	20,330	400	− 1,160
cyanide	Ni, C_2, N_2	precip.	−23,400		
dithionate	Ni, O_2, $2SO_2.6H_2O$	solid	+154,790	400	− 2,420
fluoride	Ni, F_2, Aq	dil. sol.	120,800		
hydroxide (ic)	Ni_2, O_3, $3H_2O$	solid	120,380		
hydroxide (ic)	$2Ni(OH)_2$, O, H_2O	solid	−1,300		
hydroxide (ous)	Ni, O, H_2O	solid	+60,840		
iodide	Ni, I_2, Aq	dil. sol.	41,400		
nitrate	Ni, O, N_2O_5, Aq	dil. sol.	83,420		
nitrate	Ni, N_2, O_6, $6H_2O$	solid	120,710	400	− 7,470
oxide	Ni, O	solid	57,900		
selenide	Ni, Se	precip.	14,700		
selenide	Ni, Se	cryst.	9,900		
sulphate	Ni, O, SO_3, Aq	dil. sol.	86,950		
sulphate	Ni, O_2, SO_2, $7H_2O$	solid	162,530	800	− 4,250
sulphide	Ni, S, xH_2O	solid	17,390		
telluride	Ni, Te	cryst.	11,600		
Nitric acid	N, O_3, H	liquid	41,600	300	+ 7,480
acid	N, O_3, H	gas	34,400		
Nitrogen					
carbide	N_2C_2	gas			−73,000
oxide (ic)	N, O	gas	−21,600		
oxide (ous)	N_2, O	gas	−20,600		
oxide (ous)	N_2, O	liquid	−18,000		
oxide, pent-	N_2, O_5	gas	−1,200		
oxide, pent-	N_2, O_5	liquid	+3,600		
oxide, pent-	N_2, O_5	solid	11,900		
oxide, tetr-	N_2, O_4	gas	−2,650		
oxide, tri-	N_2, O_3	gas	−21,400		
selenide	N, Se	solid	−42,300		
sulphide	N, S	solid	−31,900		
Oxalic acid	H_2, C_2, O_4	solid	+197,600		
oxalic acid	$H_2C_2O_4.2H_2O$			530	− 8,590
Palladium					
am. chloride	$PdCl_2$, $2NH_3$	solid	40,000		
am. chloride	$PdCl_2$, $2NH_3$, $2NH_3$	solid	31,000		
am. iodide	PdI_2, $2NH_3$	solid	34,000		

HEATS OF FORMATION AND SOLUTION (Continued)

Name.	Formula.	Physical state.	Heat of formation. Calories.	Water mols.	Heat of solution. Calories.
Palladium					
am. iodide	$PdI_2, 2NH_2, 2NH_3$	solid	25,800	...	...
bromide	Pd, Br_2	solid	24,900	...	...
cyanide	Pd, C_2, N_2	solid	−52,600	...	...
hydroxide	Pd, O, H_2O	solid	+21,000	...	...
hydroxide	$Pd, O_2, 2H_2O$	solid	30,430	...	...
iodide	Pd, I_2	precip.	13,400	...	...
iodide	$Pd. I_2, H_2O$	solid	18,180	...	...
pot. bromide	$PdBr_2, 2KBr, Aq$	dil. sol.	2,800	...	...
pot. chloride	$Pd, Cl_2, 2KCl$	solid	52,670	...	...
Perchloric acid	Cl, O_4, H	liquid	18,800	...	+20,300
Periodic acid	I, O_4, H, Aq	dil. sol.	47,680	...	...
Permanganic acid	Mn_2, O_7, H_2O, Aq	dil. sol.	2×93,550	...	...
Phosphonium					
bromide	$P,^* H_4, Br$	solid	40,300	...	...
iodide	$P,^* H_4, I$	solid	28,100	...	...
Phosphoric acid					
meta-	P, O_3, H	solid	226,600	...	+10,100
ortho-	P, O_4, H_3	liquid	300,080	200	+ 5,350
ortho-	P, O_4, H_3	solid	302,600	120	+ 2,690
pyro-	P_2, O_7, H_4	liquid	533,400	...	...
pyro-	P_2, O_7, H_4	solid	535,700	...	+ 7,900
Phosphorous acid					
hypo-	P, O_2, H_2	liquid	137,660	...	...
hypo-	P, O_2, H_3	solid	139,970	...	−170
ortho-	P, O_3, H_3	liquid	224,630	120	+ 2,940
ortho-	P, O_3, H_3	solid	227,700	120	−130
pyro-	P_2, O_5, H_4, Aq	solid	369,900	550	+35,600
Phosphorus					
bromide, tri-	P, Br_3	solid	44,800	...	...
bromide, penta-	P, Br_5	solid	59,050	...	...
chloride, tri-	P, Cl_3	liquid	76,600	1000	+65,140
chloride, tri-	P, Cl_3	gas	69,700	...	...
chloride, penta-	P, Cl_5	solid	109,200	...	...
hydride (phosphine)	$P,^* H_3$	gas	4,900	...	...
hydride (solid)	$P_{12},^* H_6$	solid	53,400	...	...
iodide, tri-	P, I_3	solid	10,900	...	...
iodide, tetr-	P_2, I_4	solid	19,800	...	...
nitride	$P_3,^* N_5$	solid	81,500	...	...
oxide, pent-	P_2, O_5	solid	365,200	550	+35,600
oxybromide	P, O, Br_3	solid	105,800	...	...
oxychloride	P, O, Cl_3	solid	143,900	...	...
sulphide, sesqui-	P_4, S_3	solid	77,530	...	...
Platinic acid					
brom-	$H_2PtBr_6.9H_2O$	...	...	...	− 2,900
chlor-	$H_2PtCl_6.6H_2O$	...	...	450	+ 4,340
Platinum					
bromide	Pt, Br_4	solid	42,400	...	+ 9,860
chloride	Pt, Cl_4	solid	60,400	...	+19,600
hydride	Pt_{10}, H	solid	14,200	...	...
hydroxide	Pt, O, H_2O	solid	19,220	...	...
iodide	Pt, I_4	solid	17,400	...	...
oxide	Pt, O	solid	17,000	...	...
Potassium					
acetate	K, C_2, H_3, O_2	solid	175,700	200	+ 3,340
arsenate	K_3, As, O_4, Aq	dil. sol.	396,200	...	...
arsenate	K_2, H, As, O_4, Aq	dil. sol.	339,800	...	...
arsenate, acid	K, H_2, As, O_4, Aq	dil. sol.	284,000	...	...
bromate	K, Br, O_3	solid	84,300	200	− 9,760
bromide	K, Br	solid	95,310	200	− 5,080

* P refers to white phosphorus where starred.

HEATS OF FORMATION AND SOLUTION (Continued)

Name.	Formula.	Physical state.	Heat of formation. Calories.	Water mols.	Heat of solution. Calories.
Potassium					
bromoplatinate.	$Pt, Br_4, 2KBr$	solid	59,360	2000	−12,260
bromoplatinite.	$Pt, Br_2, 2KBr$	solid	32,310	800	−10,610
carbonate	K_2, C, O_3	solid	281,100	400	+ 6,490
carbonate	K_2O, CO_2	solid	94,260	.....	.....
carbonate	$K_2CO_3.\frac{1}{2}H_2O$	.....	.....	400	+ 4,280
carbonate	$K_2CO_3.1\frac{1}{2}H_2O$	.....	.....	400	−380
carbonate, acid (bicarbonate)	K, H, C, O_3	solid	233,300	.....	− 5,300
chlorate	K, Cl, O	solid	95,860	400	−10,040
chloride	K, Cl	solid	105,610	200	− 4,440
chloropalladate	K_2PdCl_6	.....	.....	.....	−15,000
chloroplatinate	$Pt, Cl_4, 2KCl$	solid	89,500	.....	−13,760
chloroplatinite	$Pt, Cl_2, 2KCl$	solid	45,170	600	−12,220
chlorostannate	$SnCl_4, 2KCl$	solid	24,160	800	− 3,380
chromate	K_2CrO_4	.....	.....	543	− 5,250
cyanide	K, C, N	solid	30,100	180	− 2,900[20]
cyanide	K, CN	solid	67,100	175	− 3,010
cyanate	K, C, N, O	solid	102,500	660	− 5,200[20°]
dichromate	K_2, C_2O_3, O_4	solid	226,440	400	−16,700
dithionate see *thionate, di-*					
ferricyanide	K_3, Fe, C_6, N_6	solid	41,600	400	−14,400[12°]
ferricyanide	$K_3, Fe, 6CN$	solid	263,300	.....	.....
ferrocyanide	K_4, Fe, C_6, N_6	solid	137,200	820	−12,000[12°]
ferrocyanide	$K_4, Fe, 6CN$	solid	358,900	.....	.....
ferrocyanide	$K_4Fe(CN)_6.3H_2O$	.....	.....	940	−16,900[11°]
fluoride	K, F	solid	118,100	.....	+ 3,600[20°]
fluoride	$KF.2H_2O$	.....	.....	.....	− 1,000[20°]
fluoride, acid	KF, HF	solid	21,100	400	− 6,000
fluosilicate	$2KF, SiF_4$	solid	52,800	.....	.....
hydroxide	K_2, O, H_2O	solid	137,980	.....	.....
hydroxide	K, O, H	solid	104,600	250	+13,290
hypochlorite	K, Cl, O, Aq	dil. sol.	88,010	.....	.....
iodate	K, I, O_3	solid	124,490	500	− 6,780
iodate, acid	KIO_3, HIO_3	solid	3,300	865	−11,800
iodide	K, I	solid	80,130	200	− 5,110
iodide, tri-	KI, I_2	solid	13,600	.....	.....
nitrate	K, N, O_3	solid	119,000	200	− 8,520
nitrite	K, N, O_2, Aq	dil. sol.	88,900	.....	.....
oxalate	K_2, C_2, O_4	solid	324,700	165–930	− 4,740[15°]
oxalate	$K_2C_2O_4.H_2O$	.....	.....	800	− 7,410
oxalate, acid	K, H, C_2, O_4	solid	266,900	.....	− 9,600
oxalate, tetra-	$KHC_2O_4.H_2C_2O_4$	.....	.....	.....	−15,700
oxide	K_2, O	solid	86,800	.....	+75,000
perchlorate	K, Cl, O_4	solid	113,500	200–400	12,100[10°]
periodate	K, I, O_4, Aq	dil. sol.	107,700	.....	.....
permanganate	K, Mn, O_4	solid	200,050	700	−10,200[16°]
phos., ortho-	K_3, P, O_4, Aq	dil. sol.	483,600	.....	.....
phos. hydrogen	K_2, H, P, O_4, Aq	dil. sol.	429,200	.....	.....
phos. dihydro-	K, H_2, P, O_4, Aq	dil. sol.	374,400	.....	.....
phos. dihydro-	KH_2PO	.....	.....	.....	− 4,850
selenide	K_2, Se	solid	79,600	1762–1965	+ 8,500[13°]
selenide	$K_2Se.9H_2O$	.....	.....	921–4844	−19,200[14°]
selenide	$K_2Se.14H_2O$	.....	.....	2145–5914	−20,400[13°]
selenide	$K_2Se.19H_2O$	.....	.....	.....	−29,300[14°]
sulphate	K_2, S, O_4	solid	344,300	400	− 6,380
sulphate	K_2, SO_2, O_2	solid	273,560	.....	.....

HEATS OF FORMATION AND SOLUTION (Continued)

Name.	Formula.	Physical state.	Heat of formation. Calories.	Water mols.	Heat of solution. Calories.
Potassium					
sulphate, acid	K, H, S, O_4	solid	276,100	200	− 3,800
sulphate, per-	K_2, S_2, O_8	solid	454,500	3300	−14,550
sulphate, pyro-	K_2, S_2, O_7	solid	474,200	.....	.....
sulphide mono-	K_2, S	solid	103,500	732	$+10{,}000^{18°}$
sulphide mono-	$K_2S.2H_2O$	.....	.....	.....	$+ 3{,}800^{18°}$
sulphide mono-	$K_2S.5H_2O$	.....	.....	.....	$- 5{,}200^{16°}$
sulphide, tetra-	K_2, S_4	solid	118,600	600	$+ 1{,}400^{10°}$
sulphide tetra-	$K_2S_4.\frac{1}{2}H_2O$	.....	.....	.....	$- 1{,}212^{16°}$
sulphite	K_2, S, O_3	solid	273,200	350	$+ 1{,}440^{12°}$
sulphite	$K_2SO_3.H_2O$	.....	.....	245	$+ 1{,}100^{12°}$
sulphide, acid	K, H, S, O_3, Aq	dil. sol.	211,300	.....	.....
sulphocyanate	K, C, N, S	solid	49,300	200	$- 6{,}100^{13°}$
sulphocyanate	$K, C\,N, S$	solid	86,700	.....	.....
sulphydrate	K, S, H	solid	64,500	154–1568	$+770^{17°}$
sulphydrate	$KSH.\frac{1}{2}H_2O$	.....	.....	.....	$+600^{18°}$
thionate, di-	K_2, S_2, O_6	solid	415,720	500	−13,010
thionate, tri-	K_2, S_3, O_6	solid	405,850	500	−12,460
thionate, tetra-	K_2, S_4, O_6	solid	397,210	500	−13,150
thionate, penta-	K_2, S_5, O_6	solid	390,100	.....	.....
thionate, penta-	$K_2S_5O_6.1\frac{1}{2}H_2O$	.....	.....	2030	$-13{,}100^{10°}$
thiosulphate	K_2, S_2, O_3	solid	272,300	950	$- 5{,}000^{10°}$
thiosulphate	$K_2S_2O_3.H_2O$	.....	.....	.....	$- 6{,}200^{14°}$
Praseodymium					
oxide, tri-	Pr_2, O_3	solid	412,400	.....	.....
Rubidium					
bromide	Rb, Br	solid	95,700	.....	− 2,450
carbonate	Rb_2O, CO_2	solid	97,420	.....	+ 9,077
carbonate, acid	Rb, H, C, O	solid	231,920	.....	+ 4,731
chloride	Rb, Cl	solid	105,000	.....	$- 4{,}460^{15°}$
fluoride	Rb, F	solid	107,950	.....	+ 5,800
hydroxide	Rb, O, H	solid	101,990	.....	$+14{,}264^{15°}$
hydroxide	$RbOH.H_2O$	.....	.....	.....	$+3{,}700^{25°}$
hydroxide	$RbOH.2H_2O$	.....	.....	.....	$-650^{15°}$
iodide	Rb, I	solid	80,650	.....	+300
oxide	Rb_2, O	solid	83,500	.....	+80,000
sulphate	Rb_2, S, O_4	solid	344,680	.....	− 6 600
sulphate, acid	Rb, H, S, O_4	solid	277,370	.....	− 3,730
Selenium					
chloride	Se_2,* Cl_2	liquid	22,150	.....	.....
chloride, tetra-	Se,* Cl_4	solid	46,160	.....	.....
hydride	Se,* H_2	gas	−19,400	.....	+ 9,300
hydride	Se (cryst.), H_2	gas	−25,100	.....	+ 9,300
hydroxide (ic)	Se, O_2, H_2	dil. sol.	+79,300	.....	.....
hydroxide (ous)	Se, O_2, H_2	solid	52,400	.....	.....
nitride	Se, N	solid	−42,300	.....	.....
oxide, di-	Se,* O_2	solid	+57,080	.....	−740
Selenic acid	Se, O_4, H_2	liquid	128,220	.....	+16,800
Selenious acid	Se, O_3, H_2, Aq	dil. sol.	124,500	.....	.....
Silicon					
carbide	Si, C	solid	2,000	.....	.....
bromide, tetra-	Si, Br_4	liquid	71,000	.....	.....
chloride, tetra-	Si, Cl_4	gas	121,800	.....	.....
chloride, tetra-	Si, Cl_4	liquid	128,100	.....	.....
fluoride, tetra-	Si, F_4	gas	239,800	.....	.....
hydride	Si, H_4	gas	−6,700	.....	.....
iodide, tetra-	Si, I_4	solid	+6,700	.....	.....
oxide, di-	Si, O_2	solid	191,000	.....	.....
sulphide	Si, S_2	solid	10,400	.....	.....
Silver acetate	Ag, C_2, H_3, O_2	solid	95,600	120	$- 4{,}300^{20°}$

* Amorphous selenuim.

HEATS OF FORMATION AND SOLUTION (Continued)

Name.	Formula.	Physical state.	Heat of formation. Calories.	Water mols.	Heat of solution. Calories.
Silver					
bromide	Ag, Br	solid	23,400		
carbide	Ag, C	solid	43,575		
carbonate	Ag_2, O, CO_2	solid	120,500		
chloride	Ag, Cl	solid	29,000		−15,900
chloride	2Ag, Cl	solid	29,500		
cyanate	Ag, C, N, O	solid	+23,100		
cyanide	Ag, C, N	solid	−31,410		
fluoride	Ag, F	solid	23,200		+ 3,400[10°]
fluoride	$AgF.2H_2O$				− 1,500[10°]
iodide	Ag, I	solid	14,200		
nitrate	Ag, N, O_3	solid	28,700	200	− 5,440
nitrite	Ag, N, O_2	solid	11,300		− 8,800
oxide	Ag_2, O	solid	7,000		
pot. bromide	AgBr, KBr	solid	−400		
pot. cyanide	AgCN, KCN	solid	+11,900	440	− 8,350[11°]
pot. iodide	AgI, KI	solid	−1,800		
pot. iodide	AgI, 3KI	solid	−900		
selenide	Ag_2, Se	precip.	+2,000		
sulphate	Ag_2, SO_2, O_2	solid	96,200	1400	− 4,480
sulphate	Ag_2, S, O_4	solid	167,100		
sulphide	Ag_2, S	solid	3,000		
sulphocyanate	Ag, C, N, S	solid	−21,900		
thionate, di-	$AgS_2O_6.2H_2O$			400	−10,360
Sodium					
acetate	Na, C_2, H_3, O_2	solid	+170,300	200	+ 3,870
acetate	$NaC_2H_3O_2$			400	− 4,810
aluminate	Na_2O, Al_2O_3	solid	30,000		
amide	Na, N, H_2	solid	33,500		
ammon. phos.	$Na(NH_4)HPO_4.4H_2O$			800	−10,750
arsenate	Na_3, As, O_4	solid	360,800		
arsenate	$Na_2AsO_4.12H_2O$			670	−12,600[20°]
arsenate, acid	Na_2, H, As, O_4, Aq	dil. sol.	329,700		
arsenate, acid	Na, H_2, As, O_4, Aq	dil. sol.	273,700		
borate, tetra-	Na_2, B_4, O_7	solid	748,100		+10,200
borate, tetra- (borax)	$Na_2B_4O_7.10H_2O$			1600	−25,860
bromide	Na, Br	solid	86,100	330	−300[10°]
				200	−190
bromide	Na, Br, $2H_2O$	solid	90,290	450	− 4,450[11°]
				300	− 4,710
bromoplatinate	2NaBr, Br_4, Pt	solid	46,790	600	9,990
bromoplatinate	2NaBr, Br_4, Pt, $6H_2O$	solid	65,330	800	− 8,550
carbide	Na, C	solid	−4,400		
carbonate	Na_2, C, O_3	solid	+ 272,640	400	+ 5,640
carbonate	Na_2O, CO_2	solid	76,880		
carbonate, acid (bicarb.)	Na, H, C, O_3	solid	227,700		− 4,300
chlorate	Na, Cl, O_3	solid	84,800	180-360	− 5,600[10°]
chloride	Na, Cl	solid	97,900	325	− 1,010
				100	− 1,180
chloroplatinate	2NaCl, Pt, Cl_4	solid	73,720	800	− 8,540
chloroplatinate	2NaCl, Pt, Cl_4, $6H_2O$	solid	92,890	900	−10,630
chromate	Na_2O, CrO_3	solid	77,000	360-720	+ 2,200[11°]
chromate	$Na_2CrO_4.10H_2O$			760	−15,800[11°]
cyanate	Na, C, N, O	solid	101,700		− 4,800[13°]
cyanide	Na, C, N	solid	23,100	100	−500[9°]
cyanide	$NaCN.\frac{1}{2}H_2O$			100	− 1,000[8°]
cyanide	NaCN.$2H_2O$				− 4,400[8°]
dithionate see under *thionate*.					

HEATS OF FORMATION AND SOLUTION (Continued)

Name.	Formula.	Physical state.	Heat of formation. Calories.	Water mols.	Heat of solution. Calories.
Sodium					
fluoride	NaF	solid	109,300	400	$-600^{12°}$
fluosilicate	$2NaF, SiF_4$	solid	35,400	.....	.....
formate	$NaCHO_2$	.....	.....	150	$-520^{12°}$
hydroxide	Na, O, H	solid	102,700	200	+ 9,940
hydroxide	Na_2, O, H_2O	solid	135,380	.....	.....
hypochlorite	Na, Cl, O, Aq	dil. sol.	84,700	.....	.....
hypophosphite	Na_2, H, P, O_2, Aq	dil. sol.	198,400	.....	.....
iodide	Na, I	solid	69,080	200	+ 1,200
iodide	$Na, I, 2H_2O$	solid	74,310	300	− 4,010
manganate	Mn, O_3, Na_2O	solid	169,000	.....	.....
manganate	MnO_2, O, Na_2O	solid	49,400	.....	.....
molybdate	MoO_2, Na_2O_2	solid	101,200	.....	.....
molybdate	MoO_3, Na_2O	solid	181,500	.....	.....
nitrate	Na, N, O_3	solid	110,700	200	− 5,030
oxalate	Na_2, C_2, O_4	solid	315,000	.....	.....
oxalate, acid	Na, H, C_2, O_4	solid	258,200	.....	.....
oxide	Na_2, O	solid	100,700	.....	+56,500
oxide, per-	Na_2, O_2	solid	119,800	.....	.....
perchlorate	Na, Cl, O_4	solid	100,300	200–400	$-3{,}500^{10°}$
phos. (trisod.)	Na_3, P, O_4	solid	452,400	.....	.....
phos. (trisod.)	$Na_3PO_4.12H_2O$	.....	.....	670	$-14{,}500^{20°}$
phos. (disod.)	Na_2, H, P, O_4	solid	414,900	400	+ 5,640
phos. (disod.)	$Na_2HPO_4.2H_2O$	.....	.....	400	−390
phos. (disod.)	$Na_2HPO_4.7H_2O$	.....	.....	.....	−11,000
phos. (disod.)	$Na_2HPO_4.12H_2O$	.....	.....	400	−22,830
phos. (monosodium)	Na, H_2, P, O_4, Aq	dil. sol.	355,000	.....	.....
phos. pyro-	Na_4, P_2O_7	.....	.....	800	+11,850
phos. pyro-	$Na_4P_2O_7.10H_2O$	.....	.....	800	−11,670
phosphite	Na_2, H, P, O	solid	285,100	550	+ 9,150
phosphite, acid	Na, H_2, P, O_3	solid	333,800	550	$+750^{15°}$
phosphite, acid	$NaH_2PO_3.2\frac{1}{2}H_2O$	.....	.....	550	$-5{,}300^{15°}$
selenate	Na_2, Se, O_4, Aq	dil. sol.	262,300	.....	.....
selenate, acid	Na, H, Se, O_4, Aq	dil. sol.	203,200	.....	.....
selenide	Na_2, Se	solid	60,900	789–2587	$+13{,}600^{14°}$
selenide, acid	Na, H, Se, Aq	dil. sol.	35,300	.....	.....
selenide	$Na_2Se.4\frac{1}{2}H_2O$	.....	.....	1030–2125	$-7{,}900^{18°}$
selenide	$Na_2Se.9H_2O$	.....	.....	723–1352	$-10{,}600^{12°}$
selenide	$Na_2Se.16H_2O$	.....	.....	1476–3572	$-22{,}000^{14°}$
stannate	Na_2O, Sn, O_2	solid	172,600	.....	.....
sulphate	Na_2, S, O_4	solid	328,100	400	fused+460 effior.+170
sulphate	$Na_2SO_4.H_2O$	.....	.....	400	− 1,900
sulphate	$Na_2, SO_2, O_2, 10H_2O$	solid	276,730	400	−18,760
sulphate, acid	Na, H, S, O_4	solid	269,100	200	+ 1,190
				330–600	−800
sulphide	Na_2, S	solid	89,300	584–1027	$+15{,}000^{14°}$
sulphide	$Na_2S.4\frac{1}{2}H_2O$	.....	.....	589–1059	− 5,000[17]
sulphide	$Na_2S.5H_2O$	.....	.....	513–1167	− 6,600[17]
sulphide	$Na_2S.9H_2O$	.....	.....	774–1495	$-16{,}720^{18°}$
sulphide, bi-	Na_2, S_2, Aq	dil. sol.	105,200	.....	.....
sulphide, tri-	Na_2, S_3, Aq	dil. sol.	107,000	.....	.....

HEATS OF FORMATION AND SOLUTION (Continued)

Name.	Formula.	Physical state.	Heat of formation. Calories.	Water mols.	Heat of solution. Calories.
Sodium					
sulphide, tetra-	Na_2, S_4	solid	99,000	600	+ 9,800[17°]
sulphocyanate	Na, C, N, S, Aq	dil. sol.	39,200	.....	.....
sulphydrate	Na, S, H	solid	56,300	.....	+ 4,400[16°]
sulphydrate	$NaSH.2H_2O$	.....	.....	.....	− 1,500[18°]
thionate, di-	Na_2, S_2, O_6	solid	398,810	400	− 5,370
thionate, di-	$Na_2, S_2, O_6, 2H_2O$	solid	405,090	400	−11,650
thionate, tri-	Na_2, S_3, O_6, Aq	dil. sol.	387,500	.....	.....
thionate, tri-	$Na_2, S_3, O_6, 3H_2O$	.....	.....	675	−10,100[10°]
thionate, tetra-	Na_2, S_4, O_6, Aq	dil. sol.	375,800	.....	.....
thionate, tetra-	$Na_2, S_4O_6.2H_2O$	.....	.....	620	− 9,700[10°]
thiosulphate	Na_2, S_2, O_3	solid	256,300	440	+ 1,700[15°]
thiosulphate	$Na_2, S_2, O_3, 5H_2O$	solid	265,070	400	−11,370
tungstate	Na_2O, WO_3	solid	94,700	.....	.....
Stannic acid	Sn, O_2, H_2O	solid	133,500	.....	.....
Stannic and Stannous salts, see under **Tin**					
Strontium acetate	Sr, C_4, H_6, O_4	solid	345,600	300	+ 5,600[12]
acetate	$Sr(C_2H_3O_2).\frac{1}{2}H_2O$	.....	.....	440	+ 5,300[12]
arsenate	Sr_3, As_2, O_8	precip.	761,000	.....	.....
bromide	Sr, Br_2	solid	158,100	400	+16,110
bromide	Sr, Br_2, $6H_2O$	solid	181,010	400	− 7,220
carbonate	Sr, C, O_3	amorp.	278,100	.....	.....
carbonate	Sr, C, O_3	cryst.	279,200	.....	.....
carbonate	SrO, CO_2	solid	57,300	.....	.....
chloride	Sr, Cl_2	solid	184,700	400	+11,140
chloride	Sr, Cl_2, $6H_2O$	solid	203,190	400	− 7,500
cyanide	Sr, C_2, N_2, Aq	dil. sol.	47,000	.....	.....
cyanide	$Sr(CN)_2.4H_2O$	.....	.....	100	− 4,150[8°]
dithionate	Sr, $2SO_2$, O_2, $4H_2O$	solid	263,610	400	− 9,250
fluoride	Sr, F_2	solid	234,400	.....	− 2,100
hydrate	Sr, H_2	solid	45,600	.....	.....
hydroxide	Sr, O_2, H_2	solid	217,300	.....	+11,640
hydroxide	Sr, O, H_2O	solid	146,140	.....	.....
hydroxide	$Sr(OH)_2.8H_2O$	.....	.....	.....	−14,640
hydroxide	$Sr(OH)_2.9H_2O$	.....	.....	.....	−14,600
iodide	Sr, I_2	solid	122,900	.....	+20,500[12°]
iodide	$SrI_2.7H_2O$	.....	.....	.....	− 4,470
nitrate	Sr, N_2, O_6	solid	219,900	400	− 4,620
nitrate	$Sr(NO_3)_2.4H_2O$	.....	.....	400	−12,300
oxide	Sr, O	solid	131,200	.....	+29,340
oxide, per-	Sr, O_2	solid	151,710	.....	.....
phosphate	Sr_3, P_2, O_8	precip.	94,700	.....	.....
selenide	Sr, Se	solid	67,600	.....	+ 7,400
sulphate	Sr, S, O_4	solid	330,090	.....	.....
sulphydrate	Sr, S_2, H_2, Aq	dil. sol.	119,750	.....	.....
Sulphur					
bromide	S_2, Br_2	liquid	2,000	.....	.....
chloride	S_2, Cl_2	liquid	14,260	.....	.....
iodide	S_2, I_2	solid	13,600	.....	.....
oxide, di-	S, O_2	gas	69,260	.....	.....
oxide, di-	S, O_2	liquid	74,700	300	+ 1,500
oxide, tri-	S, O_3	gas	91,900	.....	.....
oxide, tri-	S, O_3	liquid	103,240	1600	+39,170
oxide, di-	S, O_3	solid	103,700	.....	.....
oxide, hept-	$2S_2O_3$, O	solid	−9,710	.....	+37,290
oxychloride (ic)	S_2, O_2, Cl_2	liquid	+89,780	.....	.....
oxychloride (ic)	SO_2, Cl_2	liquid	18,700	.....	.....
oxychl. (ous)	S, O, Cl_2	gas	40,900	.....	.....
oxychl. (ous)	S, O, Cl_2	liquid	47,400	.....	.....

HEATS OF FORMATION AND SOLUTION (Continued)

Name.	Formula.	Physical state.	Heat of formation. Calories.	Water mols.	Heat of solution. Calories.
Sulphur					
pentoxy dichloride	S_2, O_5, Cl_2	liquid	159,400	.....	.....
Sulphuric acid	S, O_4, H_2	liquid	192,200	1600	+17,850
" "	SO_3, H_2O	liquid	21,300	.....	.....
sulp. acid, per-	S_2, O_8, H_2, Aq	dil. sol.	316,400	.....	.....
sulp. acid, thio-	S_2, O_3, H_2, Aq	dil. sol.	141,700	.....	.....
Tantalum					
oxide	Ta_2, O_5	solid	301,500	.....	.....
Telluric acid	Te, O_4, H_2, Aq	dil. sol.	166,740	.....	.....
Tellurium					
chloride	Te, Cl_4	solid	77,380	.....	.....
oxide	Te, O_2	solid	78,300	.....	.....
Tellurous acid	Te, O_3, H_2	solid	145,600	.....	.....
Thallium					
bromide	Tl, Br	solid	41,290	.....	.....
bromide, tri-	Tl, Br_3, Aq	dil. sol.	56,450	.....	.....
chloride	Tl, Cl	solid	48,580	4500	−10,100
chloride, tri-	Tl, Cl_3, Aq	dil. sol.	89,250	.....	.....
fluoride	Tl, F, Aq	dil. sol.	52,000	.....	.....
hydroxide (ic)	$Tl_2, O_3, 3H_2O$	solid	2×43,170	.....	.....
hydroxide (ous)	Tl, O, H	solid	56,910	235	− 3,150
iodide	Tl, I	solid	30,180	.....	.....
iodide, tri-	Tl, I_3, Aq	dil. sol.	10,820	.....	.....
nitrate (ous)	Tl, N, O_3	solid	53,150	300	− 9,970
oxide	Tl_2, O	solid	42,240	570	− 3,080
selenide	Tl_2, Se	precip.	13,400	.....	.....
sulphate (ous)	Tl_2, S, O_4	solid	220,980	1600	− 8,280
sulphate (ous)	Tl_2, SO_2, O_2	solid	149,900	.....	.....
sulphide	Tl_2, S	solid	19,650	.....	.....
Thionic acid					
thionic, di-	S_2, O_6, H_2, Aq	dil. sol.	279,440	.....	.....
thionic, tri-	S_3, O_6, H_2, Aq	dil. sol.	272,900	.....	.....
thionic, tetra-	S_4, O_6, H_2, Aq	dil. sol.	269,790	.....	.....
thionic, penta-	S_5, O_6, H_2, Aq	dil. sol.	261,200	.....	.....
Thorium					
chloride	Th, Cl_4	solid	300,200	.....	.....
oxide	Th, O_2	solid	326,000	.....	.....
Tin					
bromide (ic)	Sn, Br_4	solid	98,000	970	+16,600
bromide (ous)	Sn, Br_2	solid	61,500	.....	− 1,600
chloride (ic)	Sn, Cl_4	solid	129,800	300	+29,920
chloride (ous)	Sn, Cl_2	solid	80,790	300	+350
chloride (ous)	$SnCl_2.2H_2O$	.....	.....	200	− 5,370
hydroxide (ous)	Sn, O, H_2O	solid	68,090	.....	.....
oxide (ic)	Sn, O_2	cryst.	137,200	.....	.....
oxide (ous)	Sn, O	solid	70,700	.....	.....
pot. chloride	$SnCl_4, 2KCl$	solid	24,160	800	− 3,380
Titanium					
oxide	Ti, O_2	amorp.	215,600	.....	.....
oxide	Ti, O_2	cryst.	218,400	.....	.....
Tungsten					
oxide, di-	W, O_2	solid	131,400	.....	.....
oxide, tri-	W, O_3	solid	196,300	.....	.....
Vanadium					
oxide	V_2, O_5	solid	310,500	.....	.....
Water see *hydrogen oxide.*					
Zinc					
acetate	Zn, C_4, H_6, C_4	solid	267,400	720	+ 9,800[22°]
acetate	$Zn(C_2H_3O_2)_2.H_2O$	.....	.....	800	+ 7,000[22°]

HEATS OF FORMATION AND SOLUTION (Continued)

Name.	Formula.	Physical state.	Heat of formation. Calories.	Water mols.	Heat of solution. Calories.
Zinc					
acetate	$Zn(C_2H_3O_2)_2.2H_2O$	.....	.....	500	+ 4,200[10°]
bromide	Zn, Br_2	solid	76,000	400	+15,030
carbonate	Zn, C, O_3	precip.	194,200	.....	.....
chloride	Zn, Cl_2	solid	97,400	300	+15,630
cyanide	Zn, C_2, N_2	solid	27,900	.....	.....
dithionate	$Zn, 2SO_2, O_2, 6H_2O$	solid	173,850	.....	.....
fluoride	Zn, F_2, Aq	dil. sol.	140,000	.....	.....
hydroxide	Zn, O, H_2O	solid	82,680	.....	.....
hydroxide	Zn, O_2, H_2	solid	83,500	.....	.....
iodide	Zn, I_2	solid	49,231	400	+11,310
nitrate	$Zn, O_2, N_2O_4, 6H_2O$	solid	140,820	400	− 5,840
oxide	Zn, O	solid	84,800	.....	.....
pot. sulphate	$ZnSO_4, K_2SO_4$	solid	4,145	600	+ 7,910
pot. sulphate	$ZnSO_4, K_2SO_4, 6H_2O$	solid	23,950	600	−11,900
selenide	Zn, Se	precip.	30,300	.....	.....
selenide	Zn, Se	cryst.	29,600	.....	.....
sulphate	Zn, S, O_4	solid	229,600	400	+18,430
sulphate	Zn, O_2, SO_2	solid	158,990	.....	.....
sulphate	Zn, O_2, SO_2, H_2O	solid	167,470	400	+ 9,950
sulphate	$Zn, O_2, SO_2, 7H_2O$	solid	181,680	400	− 4,260
sulphide	Zn, S, xH_2O	solid	43,000	.....	.....
telluride	Zn, Te	solid	31,000	.....	.....
Zirconium					
oxide	Zr, O_2	solid	177,500	.....	.....

HEAT OF COMBUSTION

For Organic Compounds

The heat of combustion is given in kilogram calories per gram molecular weight of the substance when combustion takes place at atmospheric pressure and 20° C. The final products of combustion are gaseous carbon dioxide, liquid water and nitrogen gas for C, H, N compounds. For method of computing heats of formation see statement following this table.

Selections from a compilation by Kharasch, Bureau of Standards Journal of Research **2**, 359 (1929).

Name	Formula	Physical state	Heat of combustion, kg. calories
Acetaldehyde	CH_3CHO	liquid	279.0
Acetamide	CH_3CONH_2	solid	282.6
Acetanilide	$CH_3CONHC_6H_5$	solid	1,010.4
Acetic acid	CH_3CO_2H	liquid	209.4
Acetic anhydride	$(CH_3CO)_2O$	liquid	431.9
Acetone	$(CH_3)_2CO$	liquid	426.8
Acetonitrile	CH_3CN	liquid	302.4
Acetophenone	$C_6H_5COCH_3$	solid	988.9
Acetylacetone	$CH_3COCH_2COCH_3$	liquid	615.9
Acetylene	$(CH)_2$	gas	312.0
Acrolein	$CH_2{:}CHCHO$	liquid	389.6
Acrylic acid	$CH_2{:}CHCO_2H$	liquid	327.5
Adipic acid	$(CH_2)_4(CO_2H)_2$	solid	669.0
Alanine	$CH_3CH(NH_2)CO_2H$	solid	387.7
Aldol, *see β-hydroxybutyr-aldehyde*			
Alizarin, *see Dihydroxyanthraquinone*			
Allyl alcohol	$CH_2{:}CHCH_2OH$	liquid	442.4
Allylene	$CH_3C{:}CH$	gas	465.1
p-Aminoazobenzene	$H_2NC_6H_4N_2C_6H_5$	solid	1,574.0
p-Aminophenol	$HOC_6H_4NH_2$	solid	760.0
Amygdalin	$C_{20}H_{27}O_{11}N$	solid	2,348.4
Amyl acetate	$C_4H_9CO_2C_2H_5$	liquid	1,042.5
Amyl alcohol (ferm.)	$(CH_3)_2CH_2CH_2CH_2OH$	liquid	793.7
Amylene	C_5H_{10}	liquid	803.4
Anethole	$C_{10}H_{12}O$	solid	1,324.4
Aniline	$C_6H_5NH_2$	liquid	811.7
p-Anisidine	$CH_3OC_6H_4NH_2$	solid	924.0
Anisole	$C_6H_5OCH_3$	liquid	905.1
Anthracene	$C_6H_4{:}(CH)_2{:}C_6H_4$	solid	1,700.4
Anthraquinone	$C_{14}H_8O_2$	solid	1,544.5
Arabinose	$C_5H_{10}O_5$	solid	559.9
Arabitol	$C_5H_{12}O_5$	solid	661.2
Arachidic acid	$C_{20}H_{40}O_2$	solid	3,025.9
Azelaic acid	$(CH_2)_7(CO_2H)_2$	solid	1 141.7
Azobenzene	$(C_6H_5N)_2$	solid	1,555.2
Azoxybenzene	$(C_6H_5N)_2O$	solid	1,534.5
Behenic acid	$C_{22}H_{44}O_2$	solid	3,338.4
Benzalacetone	$C_6H_5CH{:}CHCOCH_3$	solid	1,257.4
Benzaldehyde	C_6H_5CHO	liquid	841.3
Benzamide	$C_6H_5CONH_2$	solid	847.6
Benzanilide	$C_6H_5CONHC_6H_5$	solid	1,575.5
Benzene	C_6H_6	liquid	782.3
Benzenediazonium nitrate	$C_6H_5N_2NO_3$	solid	782.6
Benzidine	$(C_6H_4NH_2)_2$	solid	1,560.9
Benzil	$(C_6H_5CO)_2$	solid	1,624.6
* Benzoic acid	$C_6H_5CO_2H$	solid	771.2
Benzoic anhydride	$(C_6H_5CO)_2O$	solid	1,555.1
Benzoin	$C_6H_5.CHOH.COC_6H_5$	solid	1,671.4
Benzonitrile	C_6H_5CN	liquid	865.5
Benzophenone	$(C_6H_5)_2CO$	solid	1,556.5

* Accepted value by Int. Union of Pure and Appld. Chem., Lyons, 1923

HEAT OF COMBUSTION (Continued)

For Organic Compounds

Name	Formula	Physical state	Heat of combustion, kg. calories
Benzoyl chloride	C_6H_5COCl	liquid	782.8
Benzoyl peroxide	$(C_6H_5CO)_2O_2$	solid	1,551.7
Benzyl alcohol	$C_6H_5CH_2OH$	liquid	894.3
Benzyl amine	$C_6H_5CH_2NH_2$	liquid	969.4
Benzyl carbylamine	$C_6H_5CH_2NC$	liquid	1,046.5
Benzyl chloride	$C_6H_5CH_2Cl$	liquid	886.4
Benzyl cyanide	$C_6H_5CH_2CN$	liquid	1,023.5
Borneol	$C_{10}H_{18}O$	liquid	1,469.6
Brucine	$C_{23}H_{26}O_4N_2$	solid	2,933.0
n-Butyl alcohol	C_4H_9OH	liquid	638.6
tert.-Butyl alcohol, *see Trimethyl carbinol*			
n-Butyl amine	$C_4H_9NH_2$	liquid	710.6
sec.-Butyl amine	$(CH_3)(C_2H_5):CHNH_2$	liquid	713.0
tert.-Butyl amine	$(CH_3)_3CNH_2$	liquid	716.0
tert.-Butylbenzene	$C_6H_5C(CH_3)_3$	liquid	1,400.4
n-Butyramide	$C_3H_7CONH_2$	solid	596.0
n-Butyric acid	$C_3H_7CO_2H$	liquid	524.3
n-Butyronitrile	C_3H_7CN	liquid	613.3
Caffeine	$C_8H_{10}O_2N_4$	solid	1,014.2
Camphene	$C_{10}H_{16}$	solid	1,468.8
Camphor	$C_{10}H_{16}O$	solid	1,411.0
Cane sugar, *see Sucrose*			
Capric acid	$C_9H_{18}O_2$	solid	1,458.1
Caproic acid	$C_5H_{11}CO_2H$	liquid	831.0
Carbon disulfide	CS_2	liquid	246.6
Carbon subnitride	$(C.CN)_2$	solid	514.8
Carbon tetrachloride	CCl_4	liquid	37.3
Carbonyl sulfide	COS	gas	130.5
Carvacrol	$C_{10}H_{14}O$	liquid	1,354.5
Cetyl alcohol	$C_{16}H_{34}O$	solid	2,504.5
Cetyl palmitate	$C_{32}H_{64}O$	solid	4,872.8
Chloracetic acid	$ClCH_2CO_2H$	solid	171.0
o-Chlorobenzoic acid	$ClC_6H_4CO_2H$	solid	734.5
Chloroform	$CHCl_3$	liquid	89.2
Chrysene	$C_{14}H_{10}$	solid	2,139.1
Cinnamic acid (*trans*)	$C_6H_5CH:CHCO_2H$	solid	1,040.2
Cinnamic aldehyde	$C_6H_5CH:CHCHO$	liquid	1,112.3
Cinnamic anhydride	$C_{18}H_{14}O_3$	solid	2,091.3
d-Citrene	$C_{10}H_{16}$	liquid	1,473.0
Citric acid (anhydr.)	$C_6H_8O_7$	solid	474.5
Codeine	$C_{18}H_{21}O_3N.H_2O$	solid	2,327.6
Coniine	$C_8H_{17}N$	liquid	1,275.5
Creatine (anhydr.)	$C_4H_9O_2N_3$	solid	559.8
Creatinine	$C_4H_7ON_3$	solid	563.4
o-Cresol	$CH_3C_6H_4OH$	liquid	882.6
o-Cresol	$CH_3C_6H_4OH$	solid	879.5
m-Cresol	$CH_3C_6H_4OH$	liquid	880.5
p-Cresol	$CH_3C_6H_4OH$	liquid	882.5
p-Cresol	$CH_3C_6H_4OH$	solid	880.0
m-Cresolmethyl ether	$CH_3C_6H_4OCH_3$	liquid	1,057.0
Crotonaldehyde	C_3H_5CHO	liquid	542.1
Cyanoacetic acid	$NC.CH_2CO_2H$	solid	298.8
Cyanogen	$(CN)_2$	gas	258.3
Cycloheptanol	$CH_2(CH_2)_5CHOH$	liquid	1,050.2
Cyclohexanol	$CH_2(CH_2)_4CHOH$	liquid	890.7
Cycloheptene	C_7H_{12}	liquid	1,049.9
Cycloheptane	$(CH_2)_7$	liquid	1,087.3

HEAT OF COMBUSTION (Continued)

For Organic Compounds

Name	Formula	Physical state	Heat of combustion, kg. calories
Cyclohexane	$(CH_2)_6$	liquid	937.8
Cyclohexene, *see Tetrahydrobenzene*			
Cyclopentane	$(CH_2)_5$	liquid	783.6
Cyclopropane, *see Trimethylene*			
Cymene	$C_6H_4(CH_3)(CH_3CHCH_3)$—(1, 4)	liquid	1,402.8
Decahydronaphthalene (*cis*)	$C_{10}H_{18}$	liquid	1,502.5
Decahydronaphthalene (*trans*)	$C_{10}H_{18}$	liquid	1,499.5
Decane	$C_{10}H_{22}$	liquid	1,610.2
Dextrose, *see Glucose*			
Diallyl	$(CH_3CH:CH_2)_2$	vapor	903.4
Diamyl ether	$(C_5H_{11})_2O$	liquid	1,609.3
Diamylene	$C_{10}H_{20}$	liquid	1,582.2
Dibenzyl	$(C_6H_5CH_2)_2$	solid	1,810.6
Dibenzyl amine	$(C_6H_5CH_2)_2NH$	solid	1,853.0
o-Dichlorobenzene	$C_6H_4Cl_2$	liquid	671.8
Diethylacetic acid	$(C_2H_5)_2CHCO_2H$	liquid	830.8
Diethyl amine	$(C_2H_5)_2NH$	liquid	716.9
Diethylaniline	$C_6H_5N(C_2H_5)_2$	liquid	1,451.6
Diethyl carbonate	$CO(OC_2H_5)_2$	liquid	647.9
Diethyl ether	$(C_2H_5)_2O$	liquid	651.7
Diethyl ketone	$(C_2H_5)_2CO$	liquid	735.6
Diethyl malonate	$CH_2(CO_2C_2H_5)_2$	liquid	860.4
Diethyl oxalate	$(CO_2C_2H_5)_2$	liquid	716.0
Diethyl succinate	$(CH_2CO_2C_2H_5)_2$	liquid	1,007.3
Dihydrobenzene	C_6H_8	liquid	847.8
Δ_1-Dihydronaphthalene	$C_{10}H_{10}$	liquid	1,296.3
Δ_1-Dihydronaphthalene	$C_{10}H_{10}$	solid	1,298.3
Dihydroxyanthraquinone	$C_{14}H_6O_2(OH)_2$—(1, 2)	solid	1,448.9
Diisoamyl	$[(CH_3)_2CHCH_2CH_2]_2$	liquid	1,615.8
Diisobutylene	$[(CH_3)_2CHCH_2]_2$	liquid	1,252.4
Diisopropyl	$[(CH_3)_2CH]_2$	vapor	993.9
Diisopropyl ketone	$[(CH_3)_2CH]_2CO$	liquid	1,045.5
Dimethyl amine	$(CH_3)_2NH$	liquid	416.7
Dimethylaniline	$C_6H_5N(CH_3)_2$	liquid	1,142.7
Dimethyl carbonate	$CO(OCH_3)_2$	liquid	340.8
Dimethyl ether	$(CH_3)_2O$	gas	347.6
Dimethylethyl carbinol	$C_2H_5(CH_3)_2CHOH$	liquid	784.6
Dimethyl fumarate	$(CHCO_2CH_3)_2$	solid	664.3
2, 5-Dimethylhexane	$(CH_3)_2CH.C_2H_4.CH(CH_3)_2$	liquid	1,303.3
3, 4-Dimethylhexane	$[(C_2H_5)(CH_3)CH]_2$	liquid	1,303.7
Dimethyl maleate	$(CHCO_2CH_3)_2$	solid	669.2
Dimethyl oxalate	$(CO_2CH_3)_2$	solid	401.9
2, 2-Dimethylpentane	$(CH_3)_2C.C_3H_7$	liquid	1,148.9
2, 3-Dimethylpentane	$(CH_3)_2CHCH(CH_3)C_2H_5$	liquid	1,148.9
2, 4-Dimethylpentane	$(CH_3)_2CHCH_2CH(CH_3)_2$	liquid	1,148.9
3, 3-Dimethylpentane	$(CH_3)_2C(C_2H_5)_2$	liquid	1,147.9
Dimethyl phthalate	$C_6H_4(CO_2CH_3)_2$	liquid	1,119.7
Dimethyl succinate	$(CH_2CO_2CH_3)_2$	solid	703.3
m-Dinitrobenzene	$C_6H_4(NO_2)_2$	solid	696.8
Dinitrophenol	$C_6H_3(OH)(NO_2)_2$—(1, 2, 4)	solid	648.0
Dinitrotoluene	$C_6H_3(CH_3)(NO_2)_2$—(1, 2, 4)	solid	852.8
Diphenyl	$(C_6H_5)_2$	solid	1,493.6
Diphenyl amine	$(C_6H_5)_2NH$	solid	1,536.2
Diphenyl carbinol	$(C_6H_5)_2CHOH$	solid	1,615.4
Diphenylmethane	$(C_6H_5)_2CH_2$	solid	1,655.0
Diphenylnitrosamine	$(C_6H_5)_2N.NO$	solid	1,532.6

HEAT OF COMBUSTION (Continued)

For Organic Compounds

Name	Formula	Physical state	Heat of combustion, kg. calories
Dipropargyl	$(CH{:}C.CH_2)_2$	vapor	882.9
Dipropyl ketone	$(C_3H_7)_2CO$	liquid	1,050.5
Dulcitol	$C_6H_{14}O_6$	solid	729.1
Durene	$C_6H_2(CH_3)_4$—(1, 2, 4, 5)	solid	1,393.6
Eicosane	$C_{20}H_{42}$	solid	3,183.1
Erythritol	$C_4H_{10}O_4$	solid	504.1
Ethane	C_2H_6	gas	368.4
Ethine, *see Acetylene*			
Ethyl acetate	$CH_3CO_2C_2H_5$	liquid	536.9
Ethyl acetoacetate	$CH_3COCH_2CO_2C_2H_5$	liquid	690.8
Ethyl alcohol	C_2H_5OH	liquid	327.6
Ethyl amine	$C_2H_5NH_2$	liquid	408.5
Ethylaniline	$C_6H_5NHC_2H_5$	liquid	1,121.5
Ethylbenzene	$C_2H_5C_6H_5$	liquid	1,091.2
Ethyl benzoate	$C_6H_5CO_2C_2H_5$	liquid	1,098.7
Ethyl bromide	C_2H_5Br	vapor	340.5
Ethyl *n*-butyrate	$C_3H_7CO_2C_2H_5$	liquid	851.2
Ethyl carbylamine	C_2H_5NC	liquid	477.1
Ethyl chloride	C_2H_5Cl	vapor	316.7
Ethylcycloheptane	$C_2H_5C_7H_{13}$	liquid	1,406.8
Ethyl formate	$HCO_2C_2H_5$	liquid	391.7
3-Ethylhexane	$(C_2H_5)_2CH.C_3H_7$	liquid	1,302.3
Ethyl iodide	C_2H_5I	liquid	356.0
Ethyl isobutyrate	$(CH_3)_2CHCH_2CO_2C_2H_5$	liquid	845.7
Ethyl isocyanate	C_2H_5NCO	liquid	424.5
Ethyl nitrate	$C_2H_5ONO_2$	vapor	322.4
Ethyl nitrite	C_2H_5ONO	vapor	332.6
3-Ethylpentane	$(C_2H_5)_3CH$	liquid	1,149.9
Ethyl propionate	$C_2H_5CO_2C_2H_5$	liquid	690.8
Ethyl salicylate	$HOC_6H_4CO_2C_2H_5$	liquid	1,051.2
Ethyl valerate	$C_4H_9CO_2C_2H_5$	liquid	1,017.5
Ethylene	$CH_2{:}CH_2$	gas	331.6
Ethylene chloride	$(CH_2Cl)_2$	vapor	271.0
Ethylene diamine	$(CH_2NH_2)_2$	liquid	452.6
Ethylene glycol	$(CH_2OH)_2$	liquid	281.9
Ethylene iodide	$(CH_2I)_2$	solid	324.8
Ethylene oxide	CH_2CH_2O	liquid	302.1
Ethylidene chloride	CH_3CHCl_2	liquid	267.1
Eugenol	$C_{10}H_{12}O_2$	liquid	1,286.6
Fenchane	$C_{10}H_{18}$	liquid	1,502.6
Fluorene	$(C_6H_4)_2{:}CH_2$	solid	1,584.9
Fluorobenzene	C_6H_5F	liquid	747.2
Formaldehyde	CH_2O	gas	134.1
Formamide	$HCONH_2$	solid	134.9
Formic acid	HCO_2H	liquid	62.8
l-Fructose	$C_6H_{12}O_6$	solid	675.6
Fumaric acid (*trans*)	$(CHCO_2H)_2$	solid	320.0
Furfural	C_4H_3OCHO	liquid	559.5
Galactose	$C_6H_{12}O_6$	solid	670.7
Gallic acid	$C_6H_2(OH)_3CO_2H$—(1, 3, 5, 6)	solid	633.7
d-Glucose	$C_6H_{12}O_6$	solid	673.0
Glutaric acid	$(CH_2)_3(CO_2H)_2$	solid	514.9
Glycerol	$(CH_2OH)_2CHOH$	liquid	397.0
Glyceryl tributyrate	$C_{15}H_{26}O_6$	liquid	1,941.1
Glycine	$H_2NCH_2CO_2H$	solid	234.5
Glycogen	$(C_6H_{10}O_5)_x$	solid	4,186.8
Glycollic acid	CH_2OHCO_2H	solid	166.6
Glycylglycine	$C_4H_8O_3N_2$	solid	470.7

HEAT OF COMBUSTION (Continued)

For Organic Compounds

Name	Formula	Physical state	Heat of combustion, kg. calories
n-Heptaldehyde	$CH_3(CH_2)_5CHO$	liquid	1,062.4
n-Heptane	C_7H_{16}	liquid	1,149.9
Heptine-1	$CH{:}C(CH_2)_4CH_3$	liquid	1,091.2
n-Heptyl alcohol	$CH_3(CH_2)_5CH_2OH$	liquid	1,104.9
Heptyl amine	$C_7H_{15}NH_2$	liquid	1,178.9
Heptylic acid	$C_7H_{14}O_2$	liquid	986.1
n-Hexane	C_6H_{14}	liquid	989.8
Hexachlorbenzene	C_6Cl_6	solid	509.0
Hexachlorethane	C_2Cl_6	solid	110.0
Hexadecane	$C_{16}H_{34}$	solid	2,559.1
Hexahydronaphthalene	$C_{10}H_{14}$	liquid	1,419.3
Hexamethylbenzene	$C_6(CH_3)_6$	solid	1,711.9
Hexamethylenetetramine	$(CH_2)_6N_4$	solid	1,006.7
Hexamethylethane	$[(CH_3)_3C]_2$	solid	1,301.8
Hexyl amine	$C_6H_{13}NH_2$	liquid	1,022.2
Hexylene	C_6H_{12}	liquid	952.6
Hippuric acid	$C_6H_5CONHCH_2CO_2H$	solid	1,012.4
Hydantoic acid	$C_3H_6O_3N_2$	solid	308.6
Hydrazobenzene	$(C_6H_5NH)_2$	solid	1,597.3
Hydroquinol	$C_6H_4(OH)_2$	solid	683.7
Hydroquinoldimethyl ether	$(CH_3O)_2C_6H_4$	solid	1,014.7
p-Hydroxyazobenzene	$HOC_6H_4N_2C_6H_5$	solid	1,502.0
o-Hydroxybenzaldehyde	$C_6H_4(OH)CHO$	liquid	796.0
m-Hydroxybenzaldehyde	$C_6H_4(OH)CHO$	solid	788.7
p-Hydroxybenzaldehyde	$C_6H_4(OH)CHO$	solid	792.7
m-Hydroxybenzoic acid	$HOC_6H_4CO_2H$	solid	726.1
p-Hydroxybenzoic acid	$HOC_6H_4CO_2H$	solid	725.4
β-Hydroxybutyraldehyde	$CH_3CHOHCH_2CHO$	liquid	546.6
Indigo	$C_{16}H_{10}O_2N_2$	solid	1,815.0
Indole	C_8H_7N	solid	1,022.2
Inositol	$C_6H_{12}O_6$	solid	662.1
Iodoform	CHI_3	solid	161.9
Isoamyl amine	$(CH_3)_2CHC_2H_4NH_2$	liquid	866.8
Isobutane	$(CH_3)_3CH$	gas	683.4
Isobutyl alcohol	$(CH_3)_2CH_2CH_2OH$	liquid	638.2
Isobutyl amine	$C_4H_9NH_2$	liquid	713.6
Isobutylene	$(CH_3)_2C{:}CH_2$	gas	647.2
Isobutyraldehyde	$(CH_3)_2CHCHO$	vapor	596.8
Isobutyramide	$(CH_3)_2CHCONH_2$	solid	595.9
Isobutyric acid	$(CH_3)_2CHCO_2H$	liquid	517.4
Isoeugenol	$C_{10}H_{12}O_2$	liquid	1,277.6
Isopentane	C_5H_{12}	gas	843.5(?
Isopentane	C_5H_{12}	liquid	838.3(?
Isophthalic acid	$C_6H_4(CO_2H)_2$	solid	768.3
Isopropyl alcohol	$(CH_3)_2CHOH$	liquid	474.8
Isopropylbenzene	$(CH_3)_2CHC_6H_5$	liquid	1,247.3
Isopropyltoluene	$C_6H_4(CH_3)(CH_3CHCH_3)$— (1, 3)	liquid	1,409.5
Isopropyltoluene, *see Cymene*			
Isosafrole	$C_{10}H_{10}O_2$	liquid	1,233.9
Lactic acid	$CH_3CHOHCO_2H$	liquid	326.0
Lactose (anhydr.)	$C_{12}H_{22}O_{11}$	solid	1,350.8
Lauric acid	$C_{12}H_{24}O_2$	solid	1,771.7
Leucine	$C_6H_{13}O_2N$	solid	855.6
d-Limonene	$C_{10}H_{16}$	liquid	1,471.2
Maleic acid (*cis*)	$(CHCO_2H)_2$	solid	326.1
Maleic anhydride	$(CHCO)_2O$	solid	333.9
l-Malic acid	$(CHOHCH_2){:}(CO_2H)_2$	solid	320.1

HEAT OF COMBUSTION (Continued)

For Organic Compounds

Name	Formula	Physical state	Heat of combustion, kg. calories
Malonic acid	$CH_2(CO_2H)_2$	solid	207.2
Maltose	$C_{12}H_{22}O_{11}$	solid	1,350.2
Mandelic acid	$C_6H_5CHOHCO_2H$	solid	890.3
d-Mannitol	$C_6H_{14}O_6$	solid	727.6
Menthene	$C_{10}H_{18}$	liquid	1,523.2
Menthol	$C_{10}H_{20}O$	solid	1,508.8
Mesitylene	$(CH_3)_3C_6H_3$—(1, 3, 5)	liquid	1,243.6
Mesityl oxide	$(CH_3)_2C{:}CHCOCH_3$	liquid	846.7
Mesotartaric acid	$(CHOH)_2(CO_2H)_2$	solid	276.0
Methane	CH_4	gas	210.8
Methyl acetate	$CH_3CO_2CH_3$	liquid	381.2
Methyl alcohol	CH_3OH	liquid	170.9
Methyl amine	CH_3NH_2	liquid	256.1
Methylaniline	$C_6H_5NHCH_3$	liquid	973.5
Methyl benzoate	$C_6H_5CO_2CH_3$	liquid	943.5
Methyl bromide	CH_3Br	vapor	184.0
Methyl butyl ketone	$CH_3COC_4H_9$	liquid	895.2
Methyl *tert*-butyl ketone, *see Pinacoline*			
Methyl butyrate	$C_3H_7COC_2H_3$	liquid	692.8
Methyl carbylamine	CH_3NC	liquid	320.1
Methyl chloride	CH_3Cl	gas	164.2
Methyl cinnamate	$C_{10}H_{10}O_2$	solid	1,213.0
Methylcyclobutane	$CH_3CHCH_2CH_2CH_2$	liquid	784.2
Methylcycloheptane	$CH_3C_7H_{13}$	liquid	1,244.5
Methylcyclohexane	$CH_3C_6H_{11}$	liquid	1,091.8
Methylcyclopentane	$CH_3CH.C_3H_6.CH_2$	liquid	937.9
Methyldiethyl carbinol	$CH_3(C_2H_5)_2CHOH$	liquid	927.0
Methylene chloride	CH_2Cl_2	vapor	106.8
Methylene iodide	CH_2I_2	liquid	178.4
Methylethyl ether	$CH_3OC_2H_5$	vapor	503.4
Methylethyl ketone	$CH_3COC_2H_5$	liquid	582.3
Methyl formate	HCO_2CH_3	liquid	233.1
2-Methylheptane	$(CH_3)_2CH.C_5H_{11}$	liquid	1,306.1
2-Methylhexane	$(CH_3)_2CHC_4H_9$	liquid	1,148.9
3-Methylhexane	$(C_2H_5)(CH_3)CHC_3H_7$	liquid	1,148.9
Methylhexyl ketone	$CH_3COC_6H_{13}$	liquid	1,205.1
Methyl iodide	CH_3I	liquid	194.7
Methyl isobutyrate	$(CH_3)_2CHCO_2CH_3$	liquid	694.2
Methyl isocyanate	CH_3NCO	liquid	269.4
Methylisopropyl ketone	$CH_3COCH(CH_3)_2$	liquid	733.9
Methyl lactate	$CH_3CHOHCO_2CH_3$	liquid	497.2
Methyl propionate	$C_2H_5CO_2CH_3$	vapor	552.3
Methylpropyl ketone	$CH_3COC_3H_7$	liquid	735.6
Methyl salicylate	$HOC_6H_4CO_2CH_3$	liquid	898.3
Milk sugar, *see Lactose*			
Morphine	$C_{17}H_{19}O_3N.H_2O$	solid	2,146.3
Mucic acid	$C_6H_{10}O_8$	solid	483.6
Myristic acid	$C_{14}H_{28}O_2$	solid	2,085.8
Naphthalene	$C_{10}H_8$	solid	1,232.5
α-Naphthoic acid	$C_{10}H_7CO_2H$	solid	1,231.8
β-Naphthoic acid	$C_{10}H_7CO_2H$	solid	1,227.6
α-Naphthol	$C_{10}H_7OH$	solid	1,185.4
β-Naphthol	$C_{10}H_7OH$	solid	1,187.2
α-Naphthonitrile	$C_{10}H_7CN$	solid	1,326.2
β-Naphthonitrile	$C_{10}H_7CN$	solid	1,321.0
α-Naphthoquinone	$C_{10}H_6O_2$	solid	1,100.8
β-Naphthoquinone	$C_{10}H_6O_2$	solid	1,106.4
α-Naphthyl amine	$C_{10}H_7NH_2$	solid	1,263.5

HEAT OF COMBUSTION (Continued)

For Organic Compounds

Nam	Formula	Physical state	Heat of combustion, kg. calories
β-Naphthyl amine	$C_{10}H_7NH_2$	solid	1,261.0
Narceine	$C_{23}H_{27}O_8N.2H_2O$	solid	2,802.9
Narcotine	$C_{22}H_{23}O_7N$	solid	2,644.5
Nicotine	$C_{10}H_{14}N_2$	liquid	1,427.7
o-Nitraniline	$C_6H_4(NH_2)(NO_2)$	solid	765.8
m-Nitraniline	$C_6H_4(NH_2)(NO_2)$	solid	765.2
p-Nitraniline	$C_6H_4(NH_2)(NO_2)$	solid	761.0
m-Nitrobenzaldehyde	$O_2NC_6H_4CHO$	solid	800.4
Nitrobenzene	$C_6H_5NO_2$	liquid	739.2
m-Nitrobenzoic acid	$O_2NC_6H_4CO_2H$	solid	729.1
Nitroethane	$C_2H_5NO_2$	liquid	322.2
Nitroglycerine, *see Trinitroglycerol*			
Nitromethane	CH_3NO_2	liquid	169.4
o-Nitrophenol	$HOC_6H_6NO_2$	solid	689.1
m-Nitrophenol	$HOC_6H_4NO_2$	solid	684.4
p-Nitrophenol	$HOC_6H_4NO_2$	solid	688.8
Nitropropane	$C_3H_7NO_2$	liquid	477.9
o-Nitrotoluene	$CH_3C_6H_4NO_2$	liquid	897.0
p-Nitrotoluene	$CH_3C_6H_6NO_2$	solid	888.6
Octahydronaphthalene	$C_{10}H_{16}$	liquid	1,461.7
n-Octane	C_8H_{18}	liquid	1,302.7
Octyl alcohol	$C_8H_{18}O$	liquid	1,262.0
Oleic acid	$C_{18}H_{34}O_2$	liquid	2,657.0
Oxalic acid	$(CO_2H)_2$	solid	60.2
Oxamide	$(CONH_2)_2$	solid	203.2
Palmitic acid	$C_{16}H_{32}O_2$	solid	2,398.4
Papaverine	$C_{20}H_{21}O_4N$	solid	2,478.1
Pentamethylbenzene	$C_6H(CH_3)_5$	solid	1,554.0
n-Pentane	C_5H_{12}	gas	838.3
n-Pentane	C_5H_{12}	liquid	833.4
Phenacetin	$C_{10}H_{13}O_2N$	solid	1,285.2
Phenanthraquinone	$C_{14}H_8O_2$	solid	1,544.0
Phenanthrene	$C_{14}H_{10}$	solid	1,692.5
Phenetole	$C_6H_5OC_2H_5$	liquid	1,060.3
Phenol	C_6H_5OH	solid	732.2
Phenylacetic acid	$C_6H_5CH_2CO_2H$	solid	930.2
Phenylacetylene	$C_6H_5C{:}CH$	liquid	1,024.2
Phenylalanine	$C_9H_{11}O_2N$	solid	1,111.3
p-Phenylenediamine	$C_6H_4(NH_2)_2$	solid	843.4
Phenylethylene, *see Styrene*			
Phenylglycine	$C_2H_5NHCH_2CO_2H$	solid	955.1
Phenylhydrazine	$C_6H_5N_2H_3$	solid	875.4
Phenylhydroxylamine	C_6H_5NHOH	liquid	803.7
Phenyl iodide	C_6H_5I	liquid	770.7
Phloroglucinol	$C_6H_3(OH)_3$	solid	635.7
Phthalic acid	$C_6H_4(CO_2H)_2$	solid	771.0
Phthalic anhydride	$C_6H_4(CO)_2O$	solid	783.4
Phthalimide	$C_8H_5O_2N$	solid	849.5
Picric acid	$C_6H_2(OH)(NO_2)_3$—(1, 2, 4, 6)	solid	611.8
Pinacoline	$CH_3COC(CH_3)_3$	solid	891.8
Piperidine	$C_5H_{11}N$	liquid	826.6
Piperonal	$C_8H_6O_3$	solid	870.7
Propane	C_3H_8	gas	526.3
Propine, *see Allylene*			
Propionaldehyde	C_2H_5CHO	liquid	434.2
Propionamide	$C_2H_5CONH_2$	solid	439.9
Propionic acid	$C_2H_5CO_2H$	liquid	367.2
Propionic anhydride	$(C_2H_5CO)_2O$	liquid	746.6

HEAT OF COMBUSTION (Continued)

For Organic Compounds

Name	Formula	Physical state	Heat of combustion, kg. calories
Propionitrile	C_2H_5CN	liquid	456.4
n-Propyl Icohol	C_3H_7OH	liquid	480.5
Propyl amine	$C_3H_7NH_2$	liquid	558.3
n-Propylbenzene	$C_3H_7C_6H_5$	liquid	1,246.4
Propyl bromide	C_3H_7Br	apor	497.3
Propyl carbylamine	C_3H_7NC	liquid	639.6
Propyl chloride	C_3H_7Cl	vapor	478.3
Propylene	$CH_3CH{:}CH_2$	gas	490.2
Propylene glycol	$CH_2CHOHCH_2OH$	liquid	431.0
n-Propyl iodide	C_3H_7I	liquid	514.3
n-Propyltoluene	$C_6H_4(CH_3)(C_3H_7)$—(1, 3)	liquid	1,405.4
Pseudocumene	$C_6H_3(CH_3)_3$—(1, 2, 4)	liquid	1,241.7
Pyridine	C_5H_5N	liquid	658.5
Pyrocatechol	$C_6H_4(OH)_2$	solid	684.8
Pyrogallol	$C_6H_3(OH)_3$	solid	638.7
Pyrrole	C_4H_5N	liquid	567.7
Quercitol	$C_6H_{12}O_5$	solid	704.2
Quinoline	C_9H_7N	liquid	1,123.5
Quinone	$O{:}C_6H_4{:}O$	solid	656.6
Raffinose	$C_{18}H_{32}O_{16}$	solid	2,025.5
Retene	$C_{18}H_{18}$	solid	2,306.8
Resorcinol	$C_6H_4(OH)_2$	solid	683.0
Resorcinoldimethyl ether	$(CH_3O)_2C_6H_4$	liquid	1,022.6
Rhamnose	$C_6H_{12}O_5$	solid	718.3
Safrole	$C_{10}H_{10}O_2$	liquid	1,244.1
Salicylaldehyde, *see o-Hydroxybenzaldehyde*			
* Salicylic acid	$HOC_6H_4CO_2H$—(1, 2)	solid	723.1
Sarcosine	$CH_3NHCH_2CO_2H$	solid	401.1
Sebacic acid	$(CH_2)_8(CO_2H)_2$	solid	1,297.3
Skatole	C_9H_9N	liquid	1,170.5
d-Sorbose	$C_6H_{12}O_6$	solid	668.3
Starch	$(C_6H_{10}O_5)_x$	solid	4,178.8
Stearic acid	$C_{18}H_{36}O_2$	solid	2,711.8
Strychnine	$C_{21}H_{22}O_2N_2$	solid	2,685.7
Styrene	$(C_6H_5CH)_2$	liquid	1,047.1
Suberic acid	$(CH_2)_6(CO_2H)_2$	solid	985.2
Succinic acid	$(CH_2CO_2H)_2$	solid	357.1
Succinic acid nitrile	$(CH_2CN)_2$	liquid	545.7
Succinic anhydride	$(CH_2CO)_2O$	solid	369.6
Succinimide	$C_4H_5O_2N$	solid	437.9
Sucrose	$C_{12}H_{22}O_{11}$	solid	1,349.6
Sylvestrene	$C_{10}H_{16}$	liquid	1,464.7
d-Tartaric acid	$(CHOH)_2(CO_2H)_2$	solid	275.1
d, l-Tartaric acid (anhydr.)	$(CHOH)_2(CO_2H)_2$	solid	278.4
Terephthalic acid	$C_6H_4(CO_2H)_2$	solid	770.4
Terpin hydrate	$C_{10}H_{22}O_3$	solid	1,451.0
Terpineol	$C_{10}H_{18}O$	solid	1,469.5
Tetrahydrobenzene	C_6H_{10}	liquid	891.9
Tetrahydronaphthalene	$C_{10}H_{12}$	liquid	1,352.4
Tetramethylmethane	$(CH_3)_4C$	gas	842.6
Tetraphenylmethane	$(C_6H_5)_4C$	solid	3,102.4
Tetryl	$C_7H_5N_5O_8$	solid	842.3
Thebaine	$C_{19}H_{21}O_3N$	solid	2,441.3
Thiophene	C_4H_4S	liquid	670.5
Thujane	$C_{10}H_{18}$	liquid	1,506.4
Thymol	$C_{10}H_{14}O$	liquid	1,353.4
Thymol	$C_{10}H_{14}O$	solid	1,349.7
Thymoquinone	$C_{10}H_{12}O_2$	solid	1,271.3

* Recommended as a secondary thermochemical standard.

HEAT OF COMBUSTION (Continued)

For Organic Compounds

Name	Formula	Physical state	Heat of combustion, kg. calories
Toluene	$CH_3C_6H_5$	liquid	934.2
o-Toluic acid	$CH_3C_6H_4CO_2H$	solid	928.9
m-Toluic acid	$CH_3C_6H_4CO_2H$	solid	928.6
p-Toluic acid	$CH_3C_6H_4CO_2H$	solid	926.9
o-Toluidine	$CH_3C_6H_4NH_2$	liquid	964.3
m-Toluidine	$CH_3C_6H_4NH_2$	liquid	965.3
p-Toluidine	$CH_3C_6H_4NH_2$	solid	958.4
o-Tolunitrile	$CH_3C_6H_4CN$	liquid	1,030.3
Toluquinone	$C_7H_6O_2$	solid	803.2
Triaminotriphenyl carbinol	$(C_6H_4NH_2)_3COH$	solid	2,483.5
Tribenzyl amine	$(C_6H_5CH_2)_3N$	solid	2,762.1
Trichloracetic acid	$Cl_3C.CO_2H$	solid	92.8
Triethyl amine	$(C_2H_5)_3N$	liquid	1,036.8
Triethyl carbinol	$(C_2H_5)_3CHOH$	liquid	1,080.0
Triisoamyl amine	$[(CH_3)_2CHCH_2CH_2]_3N$	liquid	2,459.3
Triisobutyl amine	$[(CH_3)_2CHCH_2]_3N$	liquid	1,973.6
Trimethyl amine	$(CH_3)_3N$	liquid	578.6
2, 2, 3-Trimethylbutane	$(CH_3)_3C.CH(CH_3)_2$	liquid	1,147.9
Trimethyl carbinol	$(CH_3)_3COH$	liquid	629.3
Trimethylene	$CH_2CH_2CH_2$	gas	496.8
Trimethylethylene	$(CH_3)_2C{:}CHCH_3$	liquid	796.0
Trimethylethylene	$(CH_3)_2C{:}CHCH_3$	vapor	803.6
2, 2, 4-Trimethylpentane	$(CH_3)_3C.CH_2CH(CH_3)_2$	liquid	1,303.9
Trinitrobenzene	$C_6H_3(NO_2)_3$—(1, 3, 5)	solid	663.7
Trinitroglycerol	$C_3H_5(NO_3)_3$	liquid	432.4
Trinitrotoluene	$C_6H_2(CH_3)(NO_2)_3$—(1, 2, 4, 6)	solid	820.7
Triphenyl amine	$(C_6H_5)_3N$	solid	2,267.8
Triphenylbenzene	$C_6H_3(C_6H_5)_3$—(1, 3, 5)	solid	2,936.7
Triphenyl carbinol	$(C_6H_5)_3CHOH$	solid	2,340.8
Triphenylmethane	$(C_6H_5)_3CH$	solid	2,388.7
Triphenyl methyl	$(C_6H_5)_3C$	solid	2,378.5
Tyrosine	$C_9H_{11}O_3N$	solid	1,070.2
Undecylic acid	$C_{11}H_{22}O_2$	solid	1,615.9
Urea	$(NH_2)_2CO$	solid	128.6
Urethane	$NH_2CO_2C_2H_5$	solid	397.2
Uric acid	$C_5H_4O_3N_4$	solid	460.2
n-Valeric acid	$C_4H_9CO_2H$	liquid	681.6
Vanillin	$C_6H_3(OH)(OCH_3)CHO$—(1, 2, 4)	solid	914.1
o-Xylene	$(CH_3)_2C_6H_4$	liquid	1,091.7
m-Xylene	$(CH_3)_2C_6H_4$	liquid	1,088.4
p-Xylene	$(CH_3)_2C_6H_4$	liquid	1,089.1
Xylose	$C_5H_{10}O_5$	solid	561.5

HEAT OF FORMATION

For Organic Compounds

The heat of formation of a compound "A" is equal to the sum of the heats of formation of the products of combustion minus the heat of combustion (see preceeding table) of the compound "A." The heat of formation of:

Free elements	0	kg-cal
CO_2 (gas)	94.38	"
$\frac{1}{2}H_2O$ (liquid from 1 H)	34.19	"
HF (dilute aqueous solution)	75.6	"
SO_2 (gas)	69.3	"
HBr (aqueous solution)	28.54	"
HCl (aqueous solution)	39.46	"
HNO_3 (aqueous solution)	49.80	"
H_2SO_4 (aqueous solution)	207.5	"

Example I

To calculate the heat of formation of methane (CH_4) where

Heat of combustion of methane = 210.8
Heat of formation of CO_2 = 94.38
Heat of formation of $\frac{1}{2}H_2O$ = 34.19

and where the combustion occurs according to the equation:

$$CH_4 + 2O_2 = CO_2 \text{ (gas)} + 2H_2O \text{ (liquid)}$$

Then the heat of formation of CH_4 = 94.38 + 4(34.19) − 210.8 = +20.34 kg-cal. per gram molecular weight.

Example II

To calculate the heat of formation of ethylene (C_2H_4) where

Heat of combustion of ethylene = 331.6

and the combustion occurs according to the equation:

$$C_2H_4 + 3O_2 = 2CO_2 + 2H_2O$$

The heat of formation of C_2H_4 = 2(94.38) + 4(34.19) − 331.6 = −6.08 kg-cal. per gram molecular weight.

Example III

To calculate the heat of formation of ethylamine ($C_2H_5NH_2$ where

Heat of combustion of ethylamine = 408.5

and the combustion occurs according to the equation:

$$C_2H_5NH_2 + 3.75O_2 = 2CO_2 + 3.5(H_2O) + N_2$$

The heat of formation of $C_2H_5NH_2$ = 2(94.38) + 7(34.19) + O(N_2) − 331.6 = +96.49 kg-cal. per gram molecular weight.

COMBUSTION CONSTANTS OF GASES

The flue products are based upon air with 21% oxygen and 79% nitrogen; flame temperatures are not corrected for dissociation; the high or gross heat value is one which would be obtained by burning in a Junker's calorimeter; it includes the heat of condensation of the water formed by combustion and assumes that all products of combustion are cooled to the initial temperature; the low or net heat value assumes that all of the products of combustion except water have been cooled to the initial temperature; the difference between the gross and the net is equal to the heat of vaporization of water at the initial temperature.

	Formula	Mol. wt.	Sp. gr. air 1	Wt. per cu. ft. dry	B.t.u. per mol. high (gross)	B.t.u. per mol. low (net)	B.t.u. per cu. ft. high (gross) 60° F. 30 in. sat'd. H_2O
Acetylene	C_2H_2	26.02	0.8981	0.06858	562,000	543,000	1456
Ammonia	NH_3	17.03	0.5878	0.04489	.....	.....	.....
Benzene	C_6H_6	78.05	2.6940	0.2057	1,413,000	1,356,000	3658
Butane	C_4H_{10}	58.08	2.0047	0.15309	1,237,000	1,142,000	3204
Butylene	C_4H_8	56.06	1.9352	0.14778	1,171,000	1,095,000	3033
Carbon dioxide	CO_2	44.00	1.5188	0.11598	.....	.....	.....
Carbon monoxide	CO	28.00	0.9665	0.07381	122,400	122,400	317.1
Ethane	C_2H_6	30.05	1.0371	0.07920	668,300	611,300	1731
Ethylene	C_2H_4	28.03	0.9676	0.07389	622,400	584,400	1613
Hydrogen	H_2	2.02	0.0695	0.00531	123,100	104,100	318.8
Hydrogen sulfide	H_2S	34.08	1.1767	0.08986	.....	.....	.....
Methane	CH_4	16.03	0.5534	0.04226	384,000	346,000	995
Naphthalene	$C_{10}H_8$	128.06	.....	.....	2,219,000	2,143,000	.....
Nitrogen	N_2	28.02	0.9671	0.07385	.....	.....	.....
Oxygen	O_2	32.00	1.1046	0.08435	.....	.....	.....
Propane	C_3H_8	44.06	1.5210	0.11615	952,000	876,000	2465
Propylene	C_3H_6	42.05	1.4513	0.11083	893,000	836,000	2313
Toluene	C_7H_8	92.06	3.1778	0.2427	1,685,000	1,609,000	4364
Xylene	C_8H_{10}	106.08	3.6616	0.27962	1,955,000	1,860,000	5064
Water	H_2O	18.02	0.6219	0.04749	.....	.....	.....

COMBUSTION CONSTANTS OF GASES (Continued)

	B.t.u. per cu. ft. low (net) 60° F. 30 in. satd. H_2O	B.t.u. per cu ft. high (gross) 60° F. 30 in. dry	B.t.u. per cu. ft. low (net) 60° F. 30 in. dry	B.t.u. per cu. ft. high (gross) 32° F. 30 in.	B.t.u. per cu. ft. low (net) 32° F. 30 in.	Theoretical flame temp. deg. F.	Cu. ft. per cu. ft. fuel gas or mol. per mol.	
							Required for combustion	
							Oxygen	Air
Acetylene	1396	1483	1433	1567	1514	4770	2.5	11.9
Ammonia								
Benzene	3509	3722	3577	3933	3774	4110	7.5	35.7
Butane	2955	3261	3010	3445	3180	3870	6.5	30.9
Butylene	2834	3087	2887	3262	3050	4030	6.0	28.5
Carbon dioxide								
Carbon monoxide	317.1	322.6	322.6	341.0	341.0	4475	0.5	2.3
Ethane	1582	1762	1612	1862.	1703	3820	3.5	16.6
Ethylene	1514	1641	1541	1734	1631	4250	3.0	14.2
Hydrogen	269.1	324.5	274.5	343.0	290.0	4010	0.5	2.3
Hydrogen sulfide							1.5	7.1
Methane	896	1012	912	1069	963	3750	2.0	9.5
Naphthalene						4100	12.0	57.1
Nitrogen								
Oxygen								
Propane	2266	2509	2309	2652	2440	3840	5.0	23.8
Propylene	2164	2354	2204	2487	2328	4090	4.5	21.4
Toluene	4165	4441	4241	4693	4481	4050	9.0	42.8
Xylene	4815	5153	4902	5446	5181	4010	10.5	50.0
Water								

COMBUSTION CONSTANTS OF GASES (Continued)

	Cu. ft. per cu. ft. fuel gas or mol. per mol.			Ignition temp. at atmospheric pressure				Inflammability in air at atmospheric pressure and ordinary temp	
	Flue products			In air		In oxygen			
	CO_2	H_2O	N_2	Deg. F.	Deg. C.	Deg. F.	Deg. C.	% lower limit mixture	% upper limit mixture
Acetylene	2.0	1.0	9.40	763–824	406–440	781–824	416–440		
Ammonia									
Benzene	6.0	3.0	28.20	1364	740	1224	662	1.4	5.5
Butane	4.0	5.0	24.45						
Butylene	4.0	4.0	22.58						
Carbon dioxide									
Carbon monoxide	1.0		1.88	1191–1216	644–658	1179–1216	637–658	6.3	71.2
Ethane	2.0	3.0	13.17	968–1166	520–630	968–1166	520–630	3.3	10.6
Ethylene	2.0	2.0	11.29	1008–1018	542–547	932–966	500–519	3.4	14.1
Hydrogen		1.0	1.88	1076–1094	580–590	1076–1094	580–590	6.2	71.4
Hydrogen sulfide	1.0	1.0	5.64						
	SO_2								
Methane	1.0	2.0	7.52	1202–1332	650–750	1033–1292	556–700	5.8	13.3
Naphthalene	10.0	4.0	45.00						
Nitrogen									
Oxygen									
Propane	3.0	4.0	18.80			914–1058	490–570		
Propylene	3.0	3.0	16.93						
Toluene	7.0	4.0	33.87	1490	810	1026	552		
Xylene	8.0	5.0	39.50						
Water									

HEATS OF COMBUSTION AND COMPOSITION OF MANUFACTURED AND NATURAL GASES

Products of combustion, theoretical flame temperatures, air required and B.T.U. of gas-air mixture are based upon air with 21 % oxygen and 79 % nitrogen; heat values are calculated from the table as given under "Combustion Constants of Gases;" flame temperatures are not corrected for dissociation; carburetted water gas, coal gas, coke-oven gases and oil gas contain a small amount of benzene and oxygen.

	Combustion Values								Composition								
	Theoretical flame temp. ° F.	B.T.U. per cu. ft., high (gross) 60° F., 30 in. Hg, satd. H_2O	B.T.U. per cu. ft., low (net) 60° F., 30 in. Hg, satd. H_2O	Cu. ft. air required per cu. ft. gas	Cu. ft. CO_2 per cu. ft. of gas burned	Cu. ft. H_2O per cu. ft. of gas burned	Cu. ft. of N_2 per cu. ft. of gas burned	High (gross) B.T.U. per cu. ft. gas-air mixture	% CO_2	% CO	% C_2H_6 (ethane)	% C_2H_4 (ethylene)	% H_2	% CH_4 (methane)	% N_2	% O_2	% C_3H_8 (propane)
Blast-furnace gas	2660	93	91.6	0.70	0.392	0.032	0.55	54.7	13.0	26.2	....	....	3.2	....	57.6	....	....
Blue water gas	4167	310	285	2.28	0.469	0.518	1.81	94.5	3.5	43.4	....	....	51.8	....	1.3	....	....
Carburetted water gas	4090	578	529	4.85	0.758	0.904	3.85	98.8	1.5	33.9	....	12.8	35.2	14.8	1.8	....	....
Coal gas	3910	634	560	5.50	0.573	1.282	4.36	97.5	1.1	9.0	....	6.6	47.0	34.0	2.3	....	....
Coke-oven gas	3430	536	476	4.65	0.420	1.205	4.71	95.0	1.4	5.1	....	2.9	57.4	28.5	4.2	0.5	....
Coke-oven gas	3860	600	538	5.28	0.529	1.206	4.21	95.6	2.6	6.1	....	5.2	47.9	33.9	3.7	0.6	....
Natural gas at Follansbee, W. Va.	3840	2469	2268	23.80	2.967	4.062	18.81	99.6	....	....	31.8	....	....	....	0.5	....	77.7
Natural gas, Follansbee residual	3830	1868	1711	17.97	2.188	3.182	14.21	98.5	....	....	79.4	....	....	....	0.6	....	20.0
Natural gas at McKean County, Pa.	3770	1482	1350	14.25	1.663	2.756	11.29	97.3	....	....	67.0	....	....	32.3	0.7	....	....
Natural gas at Sandusky, Ohio	3740	1047	946	10.04	1.087	2.045	7.98	94.7	0.2	....	12.5	....	....	83.5	3.8	....	....
Oil gas	3970	516	461	4.25	0.458	1.129	3.39	98.3	2.8	10.6	....	2.7	53.5	27.0	3.4	....	....
Producer gas	3050	136	128	1.08	0.311	0.165	1.44	65.3	5.7	22.0	....	0.4	10.5	2.6	58.8	....	....

HEATS OF COMBUSTION AND COMPOSITION OF REPRESENTATIVE COALS

Analysis on coal "as received." First name is that of the county, second name that of the mine.

	Type	B.t.u. per pound	Ultimate analysis					Proximate analysis			
			% C	% H	% N	% O	% S	% Moisture	% Volatile matter	% Fixed carbon	% Ash
Alabama:											
Bibb, Belle Ellen	Bituminous	14,140	78.3	5.3	1.4	7.6	1.2	3.2	31.0	59.6	6.2
Jefferson, Bessemer	"	14,620	81.7	4.7	1.5	6.5	0.7	2.4	24.4	68.4	4.8
Shelby, Aldrich	"	13,650	75.0	5.2	1.0	10.0	0.8	2.3	38.6	51.9	7.2
Alaska:											
Moose Creek	"	12,150	67.6	5.3	1.9	15.9	0.3	4.7	35.5	50.9	8.9
Arkansas:											
Hartford, Central No. 10	"	13,270	77.4	4.1	1.6	5.3	1.1	2.9	19.3	67.3	10.5
Huntington, No. 6 Central	Semi-bituminous	13,700	78.7	4.4	1.6	4.4	1.9	3.2	18.1	69.7	9.0
Colorado:											
Gunnison, Somerset	Bituminous	12,630	70.6	5.5	1.5	12.7	0.4	4.3	39.7	46.7	9.3
Weld, Erie	Sub-bituminous	9,520	54.8	6.3	1.2	33.8	0.3	24.6	29.8	42.0	3.6
Illinois:											
Christian, Pana	Bituminous	10,860	59.8	5.6	1.1	19.1	3.7	13.0	37.0	39.3	10.7
Franklin, Orient	"	12,160	69.0	5.4	1.6	15.0	1.0	7.3	36.7	47.9	8.1
Williamson, Herrin	"	11,860	67.1	5.2	1.5	16.7	0.9	9.4	33.0	49.0	8.6
Indiana:											
Green, Jasonville	"	11,540	64.5	5.8	1.5	19.8	1.1	13.5	36.3	42.9	7.3
Knox, South Bruceville	"	11,540	62.3	5.5	1.0	17.1	3.2	9.5	38.3	41.4	10.9
Sullivan, Vandalia	"	11,420	63.8	5.9	1.4	20.9	1.3	14.9	34.3	44.1	6.7
Iowa:											
Lucas, Chariton	"	10,240	55.8	5.7	1.1	21.5	3.2	15.4	30.5	41.5	12.6
Polk, Altoona	"	10,240	54.7	5.5	0.8	18.8	6.2	13.9	37.0	35.2	14.0
Kansas:											
Cherokee, Stone City	"	13,080	71.8	5.2	1.2	10.2	3.3	5.1	34.5	52.2	8.3
Crawford, Edison	"	12,500	68.8	4.9	1.2	8.7	4.6	3.9	34.2	50.1	11.8
Kentucky:											
Christian, Mannington	"	11,680	.....	.....	.....	.....	3.1	9.2	33.7	46.4	10.7
Webster	"	12,500	70.4	5.1	1.6	12.6	1.1	5.4	34.9	50.4	9.3
Maryland:											
Allegany, Frostburg	Semi-bituminous	13,430	76.9	4.3	1.9	4.9	1.1	2.2	17.2	69.1	10.9
Allegany, Ocean	Bituminous	14,190	81.0	4.5	1.9	4.0	1.0	1.2	17.9	73.2	7.7
Montana:											
Carbon, Washoe	Semi-bituminous	10,550	59.8	5.6	1.3	21.0	1.1	10.5	34.7	43.7	11.2
Musselshell, Roundup	"	10,690	62.0	5.6	1.0	22.7	0.7	13.6	32.9	45.5	8.1
New Mexico:											
San Juan, Farmington	Bituminous	11,630	.....	.....	.....	.....	1.3	6.9	38.1	43.0	11.9
North Dakota:											
Ward, Burlington	Lignite	6,010	37.4	6.4	0.6	45.0	0.2	36.9	24.9	27.7	10.4
Williams, Wheelock	"	5,990	35.2	7.1	0.5	47.5	1.3	42.1	25.0	24.4	8.5
Ohio:											
Columbian, New Salisbury	Bituminous	12,730	69.9	5.2	1.4	8.3	4.3	3.5	36.7	48.9	10.9
Jefferson, Yellow Creek	"	12,720	69.7	5.2	1.4	8.0	5.1	3.4	36.3	49.6	10.7
Oklahoma:											
Coal, Lehigh	"	11,260	62.8	5.0	1.5	14.5	4.3	6.6	38.6	42.9	11.9
Latimer, Degnan	"	13.630	.....	.....	.....	.....	0.9	3.7	36.8	53.8	5.6
Pittsburg, Ridgway	"	13,280	73.8	5.4	1.8	9.6	1.7	3.8	38.0	50.6	7.6

HEATS OF COMBUSTION AND COMPOSITION OF REPRESENTATIVE COALS (Continued)

	Type	B.t.u. per pound	Ultimate analysis					Proximate analysis			
			% C	% H	% N	% O	% S	% Moisture	% Volatile matter	% Fixed carbon	% Ash
Oregon:											
Coos, Beaverhill	Sub-bituminous	9,030	51.1	5.5	1.2	28.2	0.8	16.1	31.1	39.6	13.
Pennsylvania:											
Armstrong, Montgomeryville	Cannel	10,460	56.9	4.5	1.1	5.6	3.7	1.8	32.8	37.3	28.
Armstrong, W. Kittanning	Bituminous	13,040	71.4	5.3	1.3	9.1	3.1	3.4	35.5	51.3	9.
Bedford, Hopewell	"	13,810	77.4	4.1	1.4	3.4	1.0	1.6	16.3	70.0	12.
Cambria, Bakerton	Semi-bituminous	14,460	....	....	....	....	1.1	2.2	22.2	70.3	5.
Cambria, Nanty Glo	"	14,380	....	....	....	....	1.9	2.5	20.0	71.5	6.
Cambria, Windber	"	14,620	83.9	4.3	1.3	2.4	1.2	2.6	17.0	73.7	6.
Jefferson, Punxsutawney	Bituminous	13,860	76.6	5.1	1.2	7.2	2.0	2.6	30.4	59.1	7.
Somerset, Seanor	Semi-bituminous	13,740	78.5	4.3	1.2	4.5	2.5	2.4	17.3	71.4	9.
Rhode Island:											
Providence, Cranston	Anthracite	11,620	82.4	0.5	0.1	1.8	0.9	4.5	3.0	78.7	13.
Texas:											
Webb, Dolores	Cannel	11,070	59.3	5.8	1.2	12.7	2.1	4.4	46.0	30.5	19.
Virginia:											
Montgomery, Blacksburg	Semi-bituminous	12,740	75.3	3.6	0.9	4.8	0.5	1.9	14.0	68.9	15.
Pulaski, Guntan Park	Semi-anthracite	19,960	....	....	....	....	0.8	3.8	9.4	62.2	24.
Tazewell, Pocahontas	Semi-bituminous	14,610	84.0	4.7	1.2	5.2	0.5	3.0	20.3	72.2	4.
Wise, Josephine	Bituminous	13,270	73.7	5.1	1.6	8.8	0.9	2.6	33.8	53.6	10.
Washington:											
Kittitas, Ellensburg	"	11,010	61.3	5.5	1.5	14.4	1.4	10.3	30.4	43.4	15.
Thurston, Tono	Sub-bituminous	8,700	49.9	6.3	0.9	32.4	1.2	21.7	34.8	33.3	10.
West Virginia:											
Brook, Collier	Bituminous	12,940	72.1	5.3	1.4	10.5	2.6	4.4	37.4	50.1	8.
Grant, Bismarck	Semi-bituminous	13,590	....	....	....	....	2.7	3.0	16.7	71.0	9.
Mineral, Emoryville	"	12,600	....	....	....	....	2.5	2.4	16.1	65.9	15.
Ohio, Elm Grove	Bituminous	13,200	72.8	5.3	1.4	8.8	3.6	3.0	41.4	45.6	8.
Wyoming:											
Lincoln, Elkol	Sub-bituminous	10,080	57.8	6.3	0.9	31.1	0.7	20.8	35.4	40.6	3.
Lincoln, Green River	Bituminous	13,310	74.5	5.3	1.3	12.5	1.0	3.6	38.4	52.5	5.

HEAT OF COMBUSTION

For Various Substances

Heat of combustion in kilogram calories per gram of substance. Products of combustion are gaseous unless stated.

Substance	Kg-cal. per gram of substance	Observer
Asphalt	9.532	Slossen & Colburn
Butter	9.200	.....
Carbon, crystal to CO_2	7.859	Berthelot
Casein	5.860	.....
Charcoal to CO_2	8.080	Favre & Silbermann
	8.137	Berthelot
Dynamite, 75%	1.290	Roux & Sarran
Egg white	5.700	.....
Egg yolk	8.100	.....
Fats, animal, mean	9.500	.....
Graphite	7.901	Berthelot
Gunpowder	0.720–0.750	.....
Hemoglobin	5.900	.....
Hydrogen, to liquid	33.900	Mean value
Hydrogen, to liquid	34.500	Berthelot
Hydrogen, to gas	29.150	Berthelot
Oil, cotton seed	9.500	.....
Oil, lard	9.200–9.400	.....
Oil, olive	9.328–9.442	Stohmann
Oil, paraffin	9.800	Mohler
Oil, rape	9.489	Stohmann
Oil, sperm	10.000	Gibson
Paraffin	10.340	Stohmann
Pitch	8.400	.....
Wood, beech	4.774	.....
Wood, birch	4.771	.....
Wood, oak	4.620	.....
Wood, pine	5.085	.....

TABLES SHOWING THE FUNCTIONS, USES AND COMPOSITIONS OF FOODS

Functions and Uses of Food in the Body.

Protein. — Builds and repairs tissue
- Albumen (white of eggs)
- Casein (curd of milk)
- Lean meat
- Gluten of grains

Fats. — Are stored as fat:
- Fat of meats, butter, olive oil, oils of corn, wheat and other grains.

Carbohydrates. — Are transformed into fat:
- Sugar, starch, etc.

All serve as fuel to yield energy in the forms of heat and muscular power.

Mineral Matter of Ash. — Shares in forming bones and assis in processes of digestion.
- Phosphates of lime potash, soda, etc.

Food is that which, taken into the body, builds tissue an yields energy.

TABLES SHOWING THE FUNCTIONS, USES AND COMPOSITIONS OF FOOD (Continued)

Dietary Standards

For a man in full vigor at moderate muscular work, per day

	Protein	Energy
	Grams	Large calories
Food eaten	100	3500
Food digested	95	3200

Mineral Matter (Required per Day)

	grams
Phosphoric acid, (P_2O_5)	3 to 4
Sulphuric acid, (SO_3)	2 to 3.5
Potassium oxide, (K_2O)	2 to 3
Sodium oxide, (Na_2O)	4 to 6
Calcium oxide, (CaO)	0.7 to 1.0
Magnesium oxide, (MgO)	0.3 to 0.5
Iron, (Fe)	0.006 to 0.012
Chlorine, (Cl)	6 to 8

These tables are compiled from charts of the United States Department of Agriculture, prepared by C. F. Langworthy, expert in charge of nutrition investigations.

Name of the food material	Protein.	Fat.	Carbo-hy-drates.	Ash.	Water.	Fuel value lg. cal-ories per lb.
Apple	0.4	0.5	14.2	0.3	84.6	290
Bacon	9.4	67.4	....	4.4	18.8	3030
Beef suet	4.7	81.8	....	0.3	13.2	3510
Butter	1.0	85.0	....	3.0	11.0	3410
Buckwheat	10.0	2.2	73.2	2.0	12.6	1600
Beefsteak	18.6	18.5	....	1.0	61.9	1130
Buttermilk	3.0	0.5	4.8	0.7	91.0	160
Bean, fresh shelled	9.4	0.6	29.1	2.0	58.9	740
Bean, green string	2.3	0.3	7.4	0.8	89.2	195
Bean, navy dry	22.5	1.8	59.6	3.5	12.6	1600
Banana	1.3	0.6	22.0	0.8	75.3	460
Codfish, fresh	12.8	0.4	....	1.2	82.6	325
Codfish, salt	21.5	0.3	....	24.7	53.5	410
Corn, dried	10.0	4.3	73.4	1.5	10.8	1800
Corn, green	3.1	1.1	19.7	0.7	75.4	500
Corn bread	7.9	4.7	46.3	2.2	38.9	1205
Cream cheese	25.9	33.7	2.4	3.8	34.2	1950
Cottage cheese	20.9	1.0	4.3	1.8	72.0	510
Cream	2.5	18.5	4.5	0.5	74.0	865

TABLES SHOWING THE FUNCTIONS, USES AND COMPOSITIONS OF FOODS—Continued

NAME OF THE FOOD MATERIAL	PROTEIN	FAT	CARBO-HYDRATES	ASH	WATER	FUEL VALUE IN CALORIES PER LB.
Candy stick			96.5	0.5	3.0	1785
Celery	1.1		3.4	1.0	94.5	85
Chestnut	10.7	7.0	74.2	2.2	5.9	1875
Cocoanut, dried	6.3	57.4	31.5	1.3	3.5	3125
Dried beef	30.0	6.6		9.1	54.3	840
Egg, whole	14.8	10.5		1.0	73.7	700
Egg, white	13.0	0.2		0.6	86.2	265
Egg, yolk	16.1	33.3		1.1	49.5	1608
Fig, dried	4.3	0.3	74.2	2.4	18.8	1475
Fruit, canned	1.1	0.1	21.1	0.5	77.2	415
Grapes	1.3	1.6	19.2	0.5	77.4	450
Grape juice, unfermented	0.2		7.4	0.2	92.2	150
Herring, smoked	36.4	15.8		13.2	34.6	1355
Honey	0.4		81.2	0.2	18.2	1520
Jelly, fruit			78.3	0.7	21.0	1455
Lard		100.0				4080
Lamb chop	17.6	28.3		1.0	53.1	1540
Mackerel	18.3	7.1		1.2	73.4	645
Macaroni	3.0	1.5	15.8	1.3	78.4	415
Milk, whole	3.3	4.0	5.0	0.7	87.0	310
Milk, skimmed	3.4	0.3	5.1	0.7	90.5	165
Molasses	2.4		69.3	3.2	25.1	1290
Oat	11.8	5.0	69.2	3.0	11.0	1720
Olive oil		100.0				4080
Oyster	6.2	1.2	3.7	2.0	86.9	235
Onion	1.6	0.3	9.9	0.6	87.6	225
Pork chop	16.9	30.1		1.0	52.0	1580
Parsnip	1.6	0.5	13.5	1.4	83.0	230
Potato	2.2	0.1	18.4	1.0	78.3	385
Peanut	25.8	38.6	22.4	2.0	9.2	2500
Peanut butter	29.3	46.5	17.1	5.0	2.1	2825
Rye	12.2	1.5	73.9	1.9	10.5	1750
Rice	8.0	2.0	77.0	1.0	12.0	1720
Rolled oats, cooked	2.8	0.5	11.5	0.7	84.5	285
Raisins	2.6	3.3	76.1	3.4	14.6	1605
Smoked ham	16.1	38.8		4.8	40.3	1940
Sugar granulated			100.0			1860
Sugar, maple			82 8	0.9	16.3	1540
Strawberry	1.0	0.6	7.4	0.6	90.4	180
Toasted bread	11.5	1.6	61.2	1.7	24.0	1420
Wheat	12.2	1.7	73.7	1.8	10.6	1750
White bread	9.2	1.3	53.1	1.1	35.3	1215
Whole wheat bread	9.7	0.9	49.7	1.3	38.4	1140
Walnut	16.6	63.4	16.1	1.4	2.5	3285

DEHYDRATION OF METALLIC SULPHATES

Metallic sulphates.	Temp. of beginning of decomposition, ° C.	Products formed.	Color of products.
$CaSO_4.2H_2O$	38	$CaSO_4.H_2O$	White
$CaSO_4.H_2O$	80	$2CaSO_4.H_2O$	White
$2CaSO_4.H_2O$	149	$CaSO_4$	White
$MgSO_4.7H_2O$	19	$MgSO_4.6H_2O$	White
$MgSO_4.6H_2O$	38	$MgSO_4.2H_2O$	White
$MgSO_4.2H_2O$	112	$MgSO_4.H_2O$	White
$MgSO_4.H_2O$	203	$MgSO_4$	White
$CdSO_4.\frac{8}{3}H_2O$	30	$CdSO_4.2H_2O$	White
$CdSO_4.2H_2O$	41	$CdSO_4.H_2O$	White
$CdSO_4.H_2O$	170	$CdSO_4$	White
$CoSO_4.7H_2O$	14	$CoSO_4.4H_2O$	Rose
$CoSO_4.4H_2O$	58	$CoSO_4.H_2O$	Lilac
$CoSO_4.H_2O$	276	$CoSO_4$	Lilac
$NiSO_4.7H_2O$	40	$NiSO_4.4H_2O$	Green
$NiSO_4.4H_2O$	106	$NiSO_4.H_2O$	Yellow
$NiSO_4.H_2O$	279	$NiSO_4$	Orange
$ZnSO_4.7H_2O$	25	$ZnSO_4.6H_2O$	White
$ZnSO_4.6H_2O$	28	$ZnSO_4.2H_2O$	White
$ZnSO_4.2H_2O$	115	$ZnSO_4.H_2O$	White
$ZnSO_4.H_2O$	225	$ZnSO_4$	White
$MnSO_4.5H_2O$	25	$MnSO_4.2H_2O$	Pale peach blossom
$MnSO_4.2H_2O$	60	$MnSO_4.H_2O$	Paler than above
$MnSO_4.H_2O$	152	$MnSO_4$	Paler than above
$CuSO_4.5H_2O$	27	$CuSO_4.3H_2O$	Blue
$CuSO_4.3H_2O$	93	$CuSO_4.H_2O$	Pale blue
$CuSO_4.H_2O$	155	$CuSO_4$	White
$Al_2(SO_4)_3.16H_2O$	51	$Al_2(SO_4)_3.13H_2O$	White
$Al_2(SO_4)_3.13H_2O$	82	$Al_2(SO_4)_3.10H_2O$	White
$Al_2(SO_4)_3.10H_2O$	97	$Al_2(SO_4)_3.7H_2O$	White
$Al_2(SO_4)_3.7H_2O$	109	$Al_2(SO_4)_3.4H_2O$	White
$Al_2(SO_4)_3.4H_2O$	180	$Al_2(SO_4)_3.H_2O$	White
$Al_2(SO_4)_3.H_2O$	316	$Al_2(SO_4)_3$	White
$FeSO_4.7H_2O$	21	$FeSO_4.4H_2O$	Light apple green
$FeSO_4.4H_2O$	80	$FeSO_4.H_2O$	White
$FeSO_4.H_2O$	406	Fe_2O_3, SO_3	Yellowish green

DECOMPOSITION OF ANHYDROUS METALLIC SULPHATES

Metallic sulphate.	Temp. at beginning of decomposition, ° C.	Temp. of energetic decomposition, ° C.	Products of decomposition.	Color of product.
$FeSO_4$	167	480	Fe_2O_3, $2SO_4$	Yellow brown
Fe_2O_3, $2SO_3$	492	560	Fe_2O_3	Red
$Bi_2(SO_4)_3$	570	639	$5Bi_2O_3$, $4(SO_3)_3$	White
$Al_2(SO_4)_3$	590	639	Al_2O_3	White
$PbSO_4$	637	705	$6PbO$, $5SO_3$	White
$CuSO_4$	653	670	$2CuO$, SO_3	Orange
$MnSO_4$	699	790	Mn_3O_4	Dark red to black
$ZnSO_4$	702	720	$3ZnO$, $2SO_3$	White
$2CuO$, SO_3	702	736	CuO	Black
$NiSO_4$	703	764	NiO	Brownish green
$CoSO_4$	720	770	CoO	Brown to black
$3ZnO$, $2SO_3$	755	767	ZnO	White
$CdSO_4$	827	846	$5CdO$, SO_3	White
$5Bi_2O_3$, $4(SO_3)_3$	870	890	Bi_2O_3(?)	Yellow
$5CdO$, SO_3	878	890	CdO	Brown
$MgSO_4$	890	972	MgO	White
Ag_2SO_4	917	925	Ag	Silver white
$6PbO$, $5SO_3$	952	962	$2PbO$, SO_3(?)	White to yellow
$CaSO_4$	1200	.....	CaO	White
$BaSO_4$	1516	.....	BaO	White

SPECIFIC GRAVITY OF AQUEOUS SOLUTIONS

The following collections of tables gives the specific gravity, grams per liter, pounds per cubic foot, and pounds per gallon for a large number of substances in aqueous solution. The three latter quantities have been computed from the per cent of the substance in solution and the specific gravity, assuming the density of water at 4° C. as unity. The U. S. gallon, cubic foot, and pound avoirdupois equivalents were used. The degree Baumé corresponding to the specific gravity is given according to the relation,

$$\text{Bé.} = 145 - \frac{145}{\text{Sp. Gr.}}.$$

The per cent by weight is indicated in every case.

The substances are arranged in alphabetical order. The specific gravity of alcohol solutions will be found in a separate group. Another table gives, with less detail, the specific gravity of solutions of many other substances.

Tables indicated by the symbol * have been computed on the basis of values for the specific gravity found in the International Critical Tables.

ACETIC ACID

Specific Gravity of Aqueous Acetic Acid Solutions

at $\frac{20°}{4°}$ C.*

Bé.	Sp. gr.	Per cent $HC_2H_3O_2$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
.....	0.9982	0	.....	.....	.....
.....	0.9996	1	9.996	0.6240	0.0834
0.2	1.0012	2	20.02	1.250	0.1671
0.4	1.0025	3	30.08	1.877	0.2510
0.6	1.0040	4	40.16	2.507	0.3351
0.8	1.0055	5	50.28	3.139	0.4196
1.0	1.0069	6	60.41	3.771	0.5042
1.2	1.0083	7	70.58	4.406	0.5890
1.4	1.0097	8	80.78	5.043	0.6741
1.6	1.0111	9	91.00	5.681	0.7594
1.8	1.0125	10	101.3	6.321	0.8450
2.0	1.0139	11	111.5	6.962	0.9307
2.2	1.0154	12	121.8	7.607	1.017
2.4	1.0168	13	132.2	8.252	1.103
2.6	1.0182	14	142.5	8.899	1.190
2.8	1.0195	15	152.9	9.547	1.276
3.0	1.0209	16	163.3	10.20	1.363
3.2	1.0223	17	173.8	10.85	1.450
3.3	1.0236	18	184.2	11.50	1.538
3.5	1.0250	19	194.8	12.16	1.625
3.7	1.0263	20	205.3	12.81	1.713
3.9	1.0276	21	215.8	13.47	1.801
4.1	1.0288	22	226.3	14.13	1.889
4.2	1.0301	23	236.9	14.79	1.977
4.4	1.0313	24	247.5	15.45	2.066
4.6	1.0326	25	258.2	16.12	2.154
4.7	1.0338	26	268.8	16.78	2.243
4.9	1.0349	27	279.4	17.44	2.332
5.1	1.0361	28	290.1	18.11	2.421
5.2	1.0372	29	300.8	18.78	2.510
5.4	1.0384	30	311.5	19.45	2.600
5.5	1.0395	31	322.2	20.12	2.689
5.7	1.0406	32	333.0	20.79	2.779
5.8	1.0417	33	343.8	21.46	2.869
6.0	1.0428	34	354.6	22.13	2.959
6.1	1.0438	35	365.3	22.81	3.049
6.2	1.0449	36	376.2	23.48	3.139
6.4	1.0459	37	387.0	24.16	3.229
6.5	1.0469	38	397.8	24.83	3.320
6.6	1.0479	39	408.7	25.51	3.411
6.8	1.0488	40	419.5	26.19	3.501

ACETIC ACID (Continued)

Specific Gravity of Aqueous Acetic Acid Solutions

AT $\frac{20°}{4°}$ C.*

Bé.	Sp. gr.	Per cent $HC_2H_3O_2$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
6.9	1.0498	41	430.4	26.87	3.592
7.0	1.0507	42	441.3	27.55	3.683
7.1	1.0516	43	452.2	28.23	3.774
7.2	1.0525	44	463.1	28.91	3.865
7.4	1.0534	45	474.0	29.59	3.956
7.5	1.0542	46	484.9	30.27	4.047
7.6	1.0551	47	495.9	30.96	4.138
7.7	1.0559	48	506.8	31.64	4.230
7.8	1.0567	49	517.8	32.32	4.321
7.9	1.0575	50	528.8	33.01	4.413
8.0	1.0582	51	539.7	33.69	4.504
8.1	1.0590	52	550.7	34.38	4.596
8.2	1.0597	53	561.6	35.06	4.687
8.3	1.0604	54	572.6	35.75	4.779
8.4	1.0611	55	583.6	36.43	4.870
8.4	1.0618	56	594.6	37.12	4.962
8.5	1.0624	57	605.6	37.80	5.054
8.6	1.0631	58	616.6	38.49	5.146
8.7	1.0637	59	627.6	39.18	5.237
8.8	1.0642	60	638.5	39.86	5.329
8.8	1.0648	61	649.5	40.55	5.420
8.9	1.0653	62	660.5	41.23	5.512
9.0	1.0658	63	671.5	41.92	5.603
9.0	1.0662	64	682.4	42.60	5.695
9.1	1.0666	65	693.3	43.28	5.786
9.1	1.0671	66	704.3	43.97	5.877
9.2	1.0675	67	715.2	44.65	5.969
9.2	1.0678	68	726.1	45.33	6.059
9.3	1.0682	69	737.1	46.01	6.151
9.3	1.0685	70	748.0	46.69	6.242
9.3	1.0687	71	758.8	47.37	6.332
9.4	1.0690	72	769.7	48.05	6.423
9.4	1.0693	73	780.6	48.73	6.514
9.4	1.0694	74	791.4	49.40	6.604
9.4	1.0696	75	802.2	50.08	6.695
9.5	1.0698	76	813.0	50.76	6.785
9.5	1.0699	77	823.8	51.43	6.875
9.5	1.0700	78	834.6	52.10	6.965
9.5	1.0700	79	845.3	52.77	7.054
9.5	1.0700	80	856.0	53.44	7.143
9.5	1.0699	81	866.6	54.10	7.232
9.5	1.0698	82	877.2	54.76	7.321
9.4	1.0696	83	887.8	55.42	7.409
9.4	1.0693	84	898.2	56.07	7.496
9.4	1.0689	85	908.6	56.72	7.582
9.3	1.0685	86	918.9	57.36	7.668
9.2	1.0680	87	929.2	58.00	7.754
9.2	1.0675	88	939.4	58.64	7.839
9.1	1.0668	89	949.5	59.27	7.923
9.0	1.0661	90	959.5	59.90	8.007
8.9	1.0652	91	969.3	60.51	8.089
8.8	1.0643	92	979.2	61.13	8.171
8.6	1.0632	93	988.8	61.73	8.252
8.5	1.0619	94	998.2	62.31	8.330
8.3	1.0605	95	1007	62.89	8.408
8.1	1.0588	96	1016	63.45	8.482
7.8	1.0570	97	1025	64.01	8.556
7.6	1.0549	98	1034	64.54	8.627
7.2	1.0524	99	1042	65.04	8.695
6.9	1.0498	100	1050	65.54	8.761

ALBUMEN

SPECIFIC GRAVITY OF AQUEOUS ALBUMEN SOLUTIONS AT 15.5° C.

Bé.	Sp. gr.	Per cent Albumen	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.37	1.0026	1	10.03	0.6259	0.0837
0.77	1.0054	2	20.11	1.255	0.1678
1.12	1.0078	3	30.23	1.887	0.2523
1.85	1.0130	5	50.65	3.162	0.4227
3.66	1.0261	10	102.6	6.406	0.8563
5.32	1.0384	15	155.8	9.724	1.300
7.06	1.0515	20	210.3	13.13	1.755
8.72	1.0644	25	266.1	16.61	2.221
10.42	1.0780	30	323.4	20.19	2.699
13.12	1.0919	35	382.2	23.86	3.189
13.78	1.1058	40	442.3	27.61	3.691
15.48	1.1204	45	504.2	31.47	4.207
17.16	1.1352	50	567.6	35.43	4.737
18.90	1.1511	55	633.1	39.52	5.283

ALUMINUM CHLORIDE

SPECIFIC GRAVITY OF AQUEOUS ALUMINUM CHLORIDE SOLUTIONS AT $\frac{18°}{4°}$ C.*

Bé.	Sp. gr.	Per cent $AlCl_3$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.1	1.0075	1	10.08	0.6290	0.0841
2.3	1.0164	2	20.33	1.269	0.1696
4.8	1.0344	4	41.38	2.583	0.3453
7.3	1.0526	6	63.16	3.943	0.5271
9.6	1.0711	8	85.69	5.349	0.7151
12.0	1.0900	10	109.0	6.805	0.9096
14.3	1.1093	12	133.1	8.310	1.111
16.6	1.1290	14	158.1	9.867	1.319
18.8	1.1491	16	183.9	11.48	1.534

ALUMINUM CHLORIDE

SPECIFIC GRAVITY OF ALUMINUM CHLORIDE SOLUTIONS AT 15° C. (GERLACH)

Bé.	Sp. gr.	Per cent Al_2Cl_6	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.0	1.0072	1	10.07	0.6288	0.0841
2.1	1.0144	2	20.29	1.267	0.1693
3.1	1.0216	3	30.65	1.913	0.2558
4.1	1.0289	4	41.16	2.570	0.3437
5.0	1.0360	5	51.80	3.234	0.4323
6.0	1.0435	6	62.61	3.909	0.5225
7.0	1.0510	7	73.57	4.593	0.6140
8.0	1.0585	8	84.68	5.286	0.7067
9.0	1.0659	9	95.93	5.989	0.8006
9.9	1.0734	10	107.3	6.701	0.8958
10.9	1.0812	11	118.9	7.425	0.9925
11.9	1.0890	12	130.7	8.158	1.091
12.8	1.0968	13	142.6	8.901	1.190
13.7	1.1047	14	154.7	9.655	1.291
14.7	1.1125	15	166.9	10.42	1.393
15.6	1.1207	16	179.3	11.19	1.496
16.6	1.1290	17	191.9	11.98	1.602
17.5	1.1372	18	204.7	12.78	1.708
18.4	1.1455	19	217.6	13.59	1.816
19.3	1.1537	20	230.7	14.40	1.926
20.2	1.1623	21	244.1	15.24	2.037
21.2	1.1709	22	257.6	16.08	2.150
22.1	1.1795	23	271.3	16.94	2.264
23.0	1.1882	24	285.2	17.80	2.380
23.8	1.1968	25	299.2	18.68	2.497
24.8	1.2058	26	313.5	19.57	2.616
25.7	1.2149	27	328.0	20.48	2.737
26.5	1.2241	28	342.7	21.40	2.860
27.4	1.2331	29	357.6	22.32	2.984
28.3	1.2422	30	372.7	23.26	3.110
29.2	1.2518	31	388.1	24.23	3.238
30.1	1.2615	32	403.7	25.20	3.369
30.9	1.2712	33	419.5	26.19	3.501
31.8	1.2808	34	435.5	27.19	3.634
32.6	1.2905	35	451.7	28.20	3.769
33.5	1.3007	36	468.3	29.23	3.908
34.4	1.3109	37	485.0	30.28	4.048
35.2	1.3211	38	502.0	31.34	4.189
36.1	1.3313	39	519.2	32.41	4.333
36.9	1.3415	40	536.6	33.50	4.478
37.8	1.3522	41	554.4	34.61	4.627

ALUMINUM SULFATE

Specific Gravity of Aqueous Aluminum Sulfate Solutions

AT $\frac{15°}{4°}$ C.*

Bé.	Sp. gr.	Per cent $Al_2(SO_4)_3$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.3	1.0093	1	10.09	0.6301	0.0842
2.8	1.0195	2	20.39	1.273	0.1702
5.6	1.0404	4	41.62	2.598	0.3473
8.4	1.0618	6	63.71	3.977	0.5317
11.2	1.0837	8	86.70	5.412	0.7235
13.9	1.1062	10	110.6	6.906	0.9232
16.6	1.1293	12	135.5	8.460	1.131
19.2	1.1529	14	161.4	10.08	1.347
21.8	1.1770	16	188.3	11.76	1.572
24.3	1.2017	18	216.3	13.50	1.805
26.8	1.2272	20	245.4	15.32	2.048
29.3	1.2534	22	275.7	17.21	2.301
31.7	1.2803	24	307.3	19.18	2.564
34.1	1.3079	26	340.1	21.23	2.838

Bé.	Sp. gr.	Per cent $Al_2(SO_4)_3 + 18H_2O$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.3	1.0093	1.948	19.66	1.227	0.1641
2.8	1.0195	3.896	39.72	2.479	0.3314
5.6	1.0404	7.791	81.06	5.060	0.6765
8.4	1.0618	11.69	124.1	7.747	1.036
11.2	1.0837	15.58	168.9	10.54	1.409
13.9	1.1062	19.48	215.5	13.45	1.798
16.6	1.1293	23.37	264.0	16.48	2.203
19.2	1.1529	27.27	314.4	19.63	2.624
21.8	1.1770	31.16	366.8	22.90	3.061
24.3	1.2017	35.06	421.3	26.30	3.516
26.8	1.2272	38.96	478.1	29.84	3.990
29.3	1.2534	42.85	537.1	33.53	4.482
31.7	1.2803	46.75	598.5	37.36	4.995
34.1	1.3079	50.64	662.4	41.35	5.528

ALUMINUM SULFATE

Specific Gravity of Aluminum Sulfate Solutions at 15° C. (Larsson)

Alum-maker's Table

Bé.	Sp. gr.	100 kg. of solution contain				
		Kg. Al_2O_3	Kg. SO_3	Kg. sulfate with 13 per cent Al_2O_3	Kg. sulfate with 14 per cent Al_2O_3	Kg. sulfate with 15 per cent Al_2O_3
0.7	1.005	0.14	0.32	1.1	1.0	0.9
1.4	1.010	0.27	0.64	2.1	2.0	1.8
2.3	1.016	0.41	0.95	3.1	2.9	2.7
3.0	1.021	0.55	1.27	4.2	3.9	3.6
3.7	1.026	0.68	1.59	5.3	4.9	4.6
4.4	1.031	0.81	1.89	6.3	5.8	5.4
5.0	1.036	0.94	2.20	7.3	6.7	6.3
5.6	1.040	1.07	2.50	8.3	7.7	7.2
6.2	1.045	1.20	2.80	9.3	8.6	8.0
6.9	1.050	1.33	3.11	10.3	9.5	8.9
7.6	1.055	1.46	3.40	11.2	10.4	9.7
8.1	1.059	1.58	3.69	12.2	11.3	10.6
8.7	1.064	1.71	3.98	13.1	12.2	11.4
9.2	1.068	1.83	4.27	14.1	13.1	12.2
9.9	1.073	1.96	4.56	15.1	14.0	13.1
10.5	1.078	2.08	4.84	16.0	14.8	13.9
11.0	1.082	2.20	5.12	16.9	15.7	14.6
11.6	1.087	2.32	5.40	17.8	16.5	15.4
12.2	1.092	2.44	5.67	18.7	17.4	16.2
12.7	1.096	2.55	5.95	19.6	18.3	17.0
13.3	1.101	2.67	6.22	20.5	19.1	17.8
13.8	1.105	2.78	6.49	21.4	19.9	18.6
14.4	1.110	2.90	6.76	22.3	20.7	19.3
14.8	1.114	3.01	7.02	23.2	21.5	20.1
15.4	1.119	3.13	7.29	24.1	22.4	20.9
15.9	1.123	3.24	7.55	24.9	23.1	21.6
16.5	1.128	3.35	7.81	25.8	23.9	22.3
16.9	1.132	3.46	8.06	26.6	24.7	23.1
17.5	1.137	3.57	8.32	27.5	25.5	23.8
17.9	1.141	3.68	8.58	28.3	26.3	24.5
18.4	1.145	3.79	8.83	29.1	27.1	25.3
18.9	1.150	3.89	9.07	30.0	27.8	26.0
19.4	1.154	4.00	9.32	30.8	28.6	26.7
19.9	1.159	4.11	9.57	31.6	29.3	27.4
20.3	1.163	4.21	9.82	32.4	30.1	28.1
20.9	1.168	4.32	10.06	33.2	30.8	28.9
21.3	1.172	4.42	10.29	34.0	31.6	29.5
21.7	1.176	4.52	10.53	34.8	32.3	30.1

ALUMINUM SULFATE (Continued)

Specific Gravity of Aluminum Sulfate Solutions at 15° C. (Larsson)

Alum-maker's Table

Bé.	Sp. gr.	100 liters of solution contain				
		Kg. Al_2O_3	Kg. SO_3	Kg. sulfate with 13 per cent Al_2O_3	Kg. sulfate with 14 per cent Al_2O_3	Kg. sulfate with 15 per cent Al_2O_3
0.7	1.005	0.14	0.33	1.1	1	0.9
1.4	1.010	0.28	0.65	2.2	2	1.9
2.3	1.016	0.42	0.98	3.2	3	2.8
3.0	1.021	0.56	1.31	4.3	4	3.7
3.7	1.026	0.70	1.63	5.4	5	4.7
4.4	1.031	0.84	1.96	6.5	6	5.6
5.0	1.036	0.98	2.28	7.5	7	6.5
5.6	1.040	1.12	2.61	8.6	8	7.5
6.2	1.045	1.26	2.94	9.7	9	8.4
6.9	1.050	1.40	3.26	10.8	10	9.3
7.6	1.055	1.54	3.59	11.8	11	10.3
8.1	1.059	1.68	3.91	12.9	12	11.2
8.7	1.064	1.82	4.24	14.0	13	12.1
9.2	1.068	1.96	4.57	15.1	14	13.1
9.9	1.073	2.10	4.89	16.2	15	14.0
10.5	1.078	2.24	5.22	17.2	16	14.9
11.0	1.082	2.38	5.55	18.3	17	15.9
11.6	1.087	2.52	5.87	19.4	18	16.8
12.2	1.092	2.66	6.20	20.5	19	17.7
12.7	1.096	2.80	6.52	21.5	20	18.7
13.3	1.101	2.94	6.85	22.6	21	19.6
13.8	1.105	3.08	7.18	23.7	22	20.5
14.4	1.110	3.22	7.50	24.8	23	21.5
14.8	1.114	3.36	7.83	25.9	24	22.4
15.4	1.119	3.50	8.16	26.9	25	23.3
15.9	1.123	3.64	8.48	28.0	26	24.3
16.5	1.128	3.78	8.81	29.1	27	25.2
16.9	1.132	3.92	9.13	30.2	28	26.1
17.5	1.137	4.06	9.46	31.2	29	27.1
17.9	1.141	4.20	9.79	32.3	30	28.0
18.4	1.145	4.34	10.11	33.4	31	28.9
18.9	1.150	4.48	10.44	34.5	32	29.9
19.4	1.154	4.64	10.76	35.5	33	30.8
19.9	1.159	4.76	11.09	36.6	34	31.7
20.3	1.163	4.90	11.42	37.7	35	32.7
20.9	1.168	5.04	11.74	38.8	36	33.6
21.3	1.172	5.18	12.07	39.9	37	34.5
21.7	1.176	5.32	12.40	40.9	38	35.5

AMMONIA

Specific Gravity of Aqueous Ammonium Hydroxid Solutions at $\frac{20°}{4°}$ C.*

Bé.	Sp. gr.	Per cent NH_3	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
10.9	0.9939	1	9.939	0.6205	0.0829
11.5	0.9895	2	19.79	1.235	0.1652
11.7	0.9811	4	39.24	2.450	0.3275
13.9	0.9730	6	58.38	3.644	0.4872
15.1	0.9651	8	77.21	4.820	0.6443
16.2	0.9575	10	95.75	5.977	0.7991
17.3	0.9501	12	114.0	7.117	0.9515
18.5	0.9430	14	132.0	8.242	1.102
19.5	0.9362	16	149.8	9.351	1.250
20.6	0.9295	18	167.3	10.44	1.396
21.7	0.9229	20	184.6	11.52	1.540
22.8	0.9164	22	201.6	12.59	1.682
23.8	0.9101	24	218.4	13.64	1.823
24.9	0.9040	26	235.0	14.67	1.961
25.9	0.8980	28	251.4	15.70	2.098
27.0	0.8920	30	267.6	16.71	2.233

Values Determined in Sealed Tubes, at $\frac{15°}{4°}$ C.

Bé.	Sp. gr.	Per cent NH_3	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
34.9	0.849	45	382.1	23.85	3.188
38.3	0.832	50	416.0	25.97	3.472
41.8	0.815	55	448.3	27.98	3.741
45.9	0.796	60	477.6	29.82	3.985
50.4	0.776	65	504.4	31.49	4.209
55.4	0.755	70	528.5	32.99	4.410
61.0	0.733	75	549.8	34.32	4.588
66.9	0.711	80	568.8	35.51	4.747
73.5	0.688	85	584.8	36.51	4.880
80.5	0.665	90	598.5	37.36	4.995
88.1	0.642	95	609.9	38.07	5.090
96.5	0.618	100	618.0	38.58	5.157

AMMONIUM HYDROXIDE

SPECIFIC GRAVITY OF AQUEOUS SOLUTIONS AT 15° C.

Specific gravity	Per cent NH_3	Total NH_3 g. per liter	Specific gravity	Per cent NH_3	Total NH_3 g. per liter
1.000	0.00	0.0	0.940	15.63	146.9
0.998	0.45	4.5	0.938	16.22	152.1
0.996	0.91	9.1	0.936	16.82	157.4
0.994	1.37	13.6	0.934	17.42	162.7
0.992	1.84	18.2	0.932	18.03	168.1
0.990	2.31	22.9	0.930	18.64	173.4
0.988	2.80	27.7	0.928	19.25	178.6
0.986	3.30	32.5	0.926	19.87	184.2
0.984	3.80	37.4	0.924	20.49	189.3
0.982	4.30	42.2	0.922	21.12	194.7
0.980	4.80	47.0	0.920	21.75	200.1
0.978	5.30	51.8	0.918	22.39	205.6
0.976	5.80	56.6	0.916	23.03	210.9
0.974	6.30	61.4	0.914	23.68	216.3
0.972	6.80	66.1	0.912	24.33	221.9
0.970	7.31	70.9	0.910	24.99	227.4
0.968	7.82	75.7	0.908	25.65	232.9
0.966	8.33	80.5	0.906	26.31	238.3
0.964	8.84	85.2	0.904	26.98	243.9
0.962	9.35	89.9	0.902	27.65	249.4
0.960	9.91	95.1	0.900	28.33	255.0
0.958	10.47	100.3	0.898	29.01	260.5
0.956	11.03	105.4	0.896	29.69	266.0
0.954	11.60	110.7	0.894	30.37	271.5
0.952	12.17	115.9	0.892	31.05	277.0
0.950	12.72	121.0	0.890	31.75	282.6
0.948	13.31	126.2	0.888	32.50	288.6
0.946	13.88	131.3	0.886	33.25	294.6
0.944	14.46	136.5	0.884	34.10	301.4
0.942	15.04	141.7	0.882	34.95	308.3

AQUA AMMONIA

Authority — W. C. Ferguson

This table has been approved and adopted as a standard b
the Manufacturing Chemists' Association of the United State
Specific Gravity determinations were made at 60° F., com
pared with water at 60° F.

From the Specific Gravities, the corresponding degrees Baum
were calculated by the following formula:

$$\text{Baumé} = \frac{140}{\text{Sp. Gr.}} - 130.$$

Baumé Hydrometers for use with this table must be graduate
by the above formula, which formula should *always* be printe
on the scale.

Atomic weights from F. W. Clarke's table of 1901. O = 16.

Allowance for Temperature

The coefficient of expansion for Ammonia Solutions varyin
with the temperature, correction must be applied according t
the following table:

Corrections to be added for each degree below 60° F.			Corrections to be subtracted for each degree above 60° F.			
Degrees Baumé	40° F.	50° F.	70° F.	80° F.	90° F.	100° F.
14	0.015 Bé.	0.017 Bé.	0.020 Bé.	0.022 Bé.	0.024 Bé.	0.026 B
16	0.021 "	0.023 "	0.026 "	0.028 "	0.030 "	0.032 "
18	0.027 "	0.029 "	0.031 "	0.033 "	0.035 "	0.037 "
20	0.033 "	0.036 "	0.037 "	0.038 "	0.040 "	0.042 "
22	0.039 "	0.042 "	0.043 "	0.045 "	0.047 "	
26	0.053 "	0.057 "	0.057 "	0.059 "		

Bé.°	Sp. gr.	Per cent NH_3.	Bé.°	Sp. gr.	Per cent NH_3.
10.00	1.0000	0.00	12.25	0.9842	3.73
10.25	0.9982	0.40	12.50	0.9825	4.16
10.50	0.9964	0.80	12.75	0.9807	4.59
10.75	0.9947	1.21	13.00	0.9790	5.02
11.00	0.9929	1.62	13.25	0.9773	5.45
11.25	0.9912	2.04	13.50	0.9756	5.88
11.50	0.9894	2.46	13.75	0.9739	6.31
11.75	0.9876	2.88	14.00	0.9722	6.74
12.00	0.9859	3.30	14.25	0.9705	7.17

AQUA AMMONIA (Continued)

Be.°	Sp. Gr.	Per cent NH_3.	Be.°	Sp. gr.	Per cent NH_3.
14.50	0.9689	7.61	22.00	0.9211	21.60
14.75	0.9672	8.05	22.25	0.9195	22.08
15.00	0.9655	8.49	22.50	0.9180	22.56
15.25	0.9639	8.93	22.75	0.9165	23.04
15.50	0.9622	9.38	23.00	0.9150	23.52
15.75	0.9605	9.83	23.25	0.9135	24.01
16.00	0.9589	10.28	23.50	0.9121	24.50
16.25	0.9573	10.73	23.75	0.9106	24.99
16.50	0.9556	11.18	24.00	0.9091	25.48
16.75	0.9540	11.64	24.25	0.9076	25.97
17.00	0.9524	12.10	24.50	0.9061	26.46
17.25	0.9508	12.56	24.75	0.9047	26.95
17.50	0.9492	13.02	25.00	0.9032	27.44
17.75	0.9475	13.49	25.25	0.9018	27.93
18.00	0.9459	13.96	25.50	0.9003	28.42
18.25	0.9444	14.43	25.75	0.8989	28.91
18.50	0.9428	14.90	26.00	0.8974	29.40
18.75	0.9412	15.37	26.25	0.8960	29.89
19.00	0.9396	15.84	26.50	0.8946	30.38
19.25	0.9380	16.32	26.75	0.8931	30.87
19.50	0.9365	16.80	27.00	0.8917	31.36
19.75	0.9349	17.28	27.25	0.8903	31.85
20.00	0.9333	17.76	27.50	0.8889	32.34
20.25	0.9318	18.24	27.75	0.8875	32.83
20.50	0.9302	18.72	28.00	0.8861	33.32
20.75	0.9287	19.20	28.25	0.8847	33.81
21.00	0.9272	19.68	28.50	0.8833	34.30
21.25	0.9256	20.16	28.75	0.8819	34.79
21.50	0.9241	20.64	29.00	0.8805	35.28
21.75	0.9226	21.12			

AMMONIUM CHLORIDE

SPECIFIC GRAVITY OF AQUEOUS AMMONIUM CHLORIDE SOLUTIONS AT $\frac{20°}{4°}$ C.*

Bé.	Sp. gr.	Per cent NH_4Cl	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.2	1.0013	1	10.01	0.6251	0.0836
0.6	1.0045	2	20.09	1.254	0.1677
1.5	1.0107	4	40.43	2.524	0.3374
2.4	1.0168	6	61.01	3.809	0.5091
3.2	1.0227	8	81.82	5.108	0.6828
4.0	1.0286	10	102.9	6.421	0.8584
4.8	1.0344	12	124.1	7.749	1.036
5.6	1.0401	14	145.6	9.090	1.215
6.3	1.0457	16	167.3	10.44	1.396
7.1	1.0512	18	189.2	11.81	1.579
7.8	1.0567	20	211.3	13.19	1.764
8.5	1.0621	22	233.7	14.59	1.950
9.2	1.0674	24	256.2	15.99	2.138

AMMONIUM NITRATE

SPECIFIC GRAVITY OF AQUEOUS AMMONIUM NITRATE SOLUTIONS AT $\frac{20°}{4°}$ C.*

Bé.	Sp. gr.	Per cent NH_4NO_3	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.3	1.0023	1	10.02	0.6257	0.0836
0.9	1.0064	2	20.13	1.257	0.1680
2.1	1.0147	4	40.59	2.534	0.3387
3.3	1.0230	6	61.38	3.832	0.5122
4.4	1.0313	8	82.50	5.150	0.6885
5.5	1.0397	10	104.0	6.491	0.8677
6.7	1.0482	12	125.8	7.852	1.050
7.8	1.0567	14	147.9	9.235	1.235
8.9	1.0653	16	170.4	10.64	1.422
10.0	1.0740	18	193.3	12.07	1.613
11.1	1.0828	20	216.6	13.52	1.807
12.2	1.0916	22	240.2	14.99	2.004
13.2	1.1005	24	264.1	16.49	2.204
14.3	1.1095	26	288.5	18.01	2.407
15.4	1.1186	28	313.2	19.55	2.614
16.4	1.1277	30	338.3	21.12	2.823
19.0	1.1512	35	402.9	25.15	3.362
21.6	1.1754	40	470.2	29.35	3.924
24.2	1.2003	45	540.1	33.72	4.508
26.7	1.2258	50	612.9	38.26	5.115

AMMONIUM NITRATE

SPECIFIC GRAVITY OF AQUEOUS AMMONIUM NITRATE SOLUTIONS AT 17.5° C. (GERLACH)

Bé.	Sp. gr.	Per cent NH_4NO_3	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.6	1.0042	1	10.04	0.6269	0.0838
1.2	1.0085	2	20.17	1.259	0.1683
1.8	1.0127	3	30.38	1.897	0.2535
2.4	1.0170	4	40.68	2.540	0.3395
3.0	1.0212	5	51.06	3.188	0.4261
3.6	1.0255	6	61.53	3.841	0.5135
4.2	1.0297	7	72.08	4.500	0.6015
4.8	1.0340	8	82.72	5.164	0.6903
5.3	1.0382	9	93.44	5.833	0.7798
5.9	1.0425	10	104.3	6.508	0.8700
6.5	1.0468	11	115.1	7.188	0.9609
7.1	1.0512	12	126.1	7.875	1.053
7.6	1.0555	13	137.2	8.566	1.145
8.2	1.0599	14	148.4	9.263	1.238
8.8	1.0642	15	159.6	9.965	1.332
9.3	1.0686	16	171.0	10.67	1.427
9.9	1.0729	17	182.4	11.39	1.522
10.4	1.0773	18	193.9	12.11	1.618
10.9	1.0816	19	205.5	12.83	1.715
11.5	1.0860	20	217.2	13.56	1.813
12.0	1.0905	21	229.0	14.30	1.911
12.6	1.0950	22	240.9	15.04	2.010
13.1	1.0995	23	252.9	15.79	2.110
13.7	1.1040	24	265.0	16.54	2.211
14.2	1.1085	25	277.1	17.30	2.313
14.7	1.1130	26	289.4	18.07	2.415
15.2	1.1175	27	301.7	18.84	2.518
15.8	1.1220	28	314.2	19.61	2.622
16.3	1.1265	29	326.7	20.39	2.726
16.8	1.1310	30	339.3	21.18	2.832
17.3	1.1358	31	352.1	21.98	2.938
17.9	1.1406	32	365.0	22.79	3.046
18.4	1.1454	33	378.0	23.60	3.154
18.9	1.1502	34	391.1	24.41	3.264
19.5	1.1550	35	404.3	25.24	3.374
20.0	1.1598	36	417.5	26.07	3.484
20.5	1.1646	37	430.9	26.90	3.596
21.0	1.1694	38	444.4	27.74	3.708
21.5	1.1743	39	457.9	28.59	3.822
22.0	1.1790	40	471.6	29.44	3.936
22.5	1.1841	41	485.5	30.31	4.051
23.1	1.1892	42	499.5	31.18	4.168

AMMONIUM NITRATE (Continued)

SPECIFIC GRAVITY OF AQUEOUS AMMONIUM NITRATE SOLUTIONS AT 17.5° C. (GERLACH)

Bé.	Sp. gr.	Per cent NH_4NO_3	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
23.6	1.1942	43	513.5	32.06	4.285
24.1	1.1994	44	527.7	32.94	4.404
24.6	1.2045	45	542.0	33.84	4.523
25.1	1.2096	46	556.4	34.74	4.643
25.6	1.2147	47	570.9	35.64	4.764
26.1	1.2198	48	585.5	36.55	4.886
26.6	1.2249	49	600.2	37.47	5.009
27.1	1.2300	50	615.0	38.39	5.132
27.6	1.2353	51	630.0	39.33	5.258
28.1	1.2407	52	645.2	40.28	5.384
28.6	1.2460	53	660.4	41.23	5.511
29.1	1.2514	54	675.8	42.19	5.639
29.6	1.2567	55	691.2	43.15	5.768
30.1	1.2621	56	706.8	44.12	5.898
30.6	1.2674	57	722.4	45.10	6.029
31.1	1.2728	58	738.2	46.09	6.161
31.6	1.2781	59	754.1	47.07	6.293
32.0	1.2835	60	770.1	48.08	6.427
32.5	1.2888	61	786.2	49.08	6.561
33.0	1.2942	62	802.4	50.09	6.696
33.5	1.3005	63	819.3	51.15	6.837
34.0	1.3059	64	835.8	52.17	6.975

AMMONIUM SULFATE

SPECIFIC GRAVITY OF AQUEOUS AMMONIUM SULFATE SOLUTIONS AT $\frac{20°}{4°}$ C.*

Bé.	Sp. gr.	Per cent $(NH_4)_2SO_4$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.6	1.0041	1	10.04	0.6283	0.08379
1.5	1.0101	2	20.20	1.621	0.1686
3.1	1.0220	4	40.88	2.552	0.3412
4.7	1.0338	6	62.03	3.872	0.5176
6.3	1.0456	8	83.65	5.222	0.6981
7.9	1.0574	10	105.7	6.601	0.8824
9.4	1.0691	12	128.3	8.009	1.071
10.8	1.0808	14	151.3	9.446	1.263
12.3	1.0924	16	174.8	10.91	1.459
13.7	1.1039	18	198.7	12.40	1.658
15.0	1.1154	20	223.1	13.93	1.862
16.3	1.1269	22	247.9	15.48	2.069
17.6	1.1383	24	273.2	17.05	2.280
18.9	1.1496	26	298.9	18.66	2.494
20.1	1.1609	28	325.1	20.29	2.713
21.3	1.1721	30	351.6	21.95	2.934
24.2	1.2000	35	420.0	26.22	3.505
26.9	1.2277	40	491.1	30.66	4.098
29.5	1.2552	45	564.8	35.26	4.714
31.9	1.2825	50	641.3	40.03	5.351

AMMONIUM SULFATE

SPECIFIC GRAVITY OF AQUEOUS AMMONIUM SULFATE SOLUTIONS AT 19° C. (SCHIFF)

Bé.	Sp. gr.	Per cent $(NH_4)_2SO_4$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.8	1.0057	1	10.06	0.6278	0.0839
1.6	1.0115	2	20.23	1.263	0.1688
2.5	1.0172	3	30.52	1.905	0.2547
3.3	1.0230	4	40.92	2.555	0.3415
4.0	1.0287	5	51.44	3.211	0.4292
4.8	1.0345	6	62.07	3.875	0.5180
5.6	1.0403	7	72.82	4.546	0.6077
6.4	1.0460	8	83.68	5.224	0.6983
7.1	1.0518	9	94.66	5.909	0.7900
7.9	1.0575	10	105.8	6.602	0.8825
8.6	1.0632	11	117.0	7.301	0.9760
9.4	1.0690	12	128.3	8.008	1.071
10.1	1.0747	13	139.7	8.722	1.166
10.8	1.0805	14	151.3	9.443	1.262
11.5	1.0862	15	162.9	10.17	1.360
12.2	1.0920	16	174.7	10.91	1.458
12.9	1.0977	17	186.6	11.65	1.557
13.6	1.1035	18	198.6	12.40	1.658
14.3	1.1092	19	210.7	13.16	1.759
14.9	1.1149	20	223.0	13.92	1.861
15.6	1.1207	21	235.3	14.69	1.964
16.3	1.1265	22	247.8	15.47	2.068
16.9	1.1323	23	260.4	16.26	2.173
17.6	1.1381	24	273.1	17.05	2.279
18.2	1.1439	25	286.0	17.85	2.387
18.9	1.1496	26	298.9	18.66	2.494
19.5	1.1554	27	312.0	19.47	2.603
20.1	1.1612	28	325.1	20.30	2.713
20.8	1.1670	29	338.4	21.13	2.824
21.3	1.1724	30	351.7	21.96	2.935
21.9	1.1780	31	365.2	22.80	3.048
22.5	1.1836	32	378.8	23.64	3.161
23.1	1.1892	33	392.4	24.50	3.275
23.6	1.1948	34	406.2	25.36	3.390
24.2	1.2004	35	420.1	26.23	3.506
24.8	1.2060	36	434.2	27.10	3.623
25.3	1.2116	37	448.3	27.99	3.741
25.9	1.2172	38	462.5	28.87	3.860
26.4	1.2228	39	476.9	29.77	3.980
27.0	1.2284	40	491.4	30.67	4.101
27.5	1.2343	41	506.1	31.59	4.223
28.1	1.2402	42	520.9	32.52	4.347
28.6	1.2462	43	535.9	33.45	4.472
29.2	1.2522	44	551.0	34.40	4.598
29.8	1.2583	45	566.2	35.35	4.725
30.3	1.2644	46	581.6	36.31	4.854
30.9	1.2705	47	597.1	37.28	4.983
31.4	1.2766	48	612.8	38.25	5.114
32.0	1.2828	49	628.6	39.24	5.246
32.5	1.2890	50	644.5	40.23	5.378

ARSENIC ACID

Specific Gravity of Aqueous Arsenic Acid Solutions at $\frac{15°}{4°}$ C.*

Bé.	Sp. gr.	Per cent H_3AsO_4	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.8	1.0057	1	10.06	0.6278	0.0839
1.8	1.0124	2	20.25	1.264	0.1690
3.7	1.0260	4	41.04	2.562	0.3425
5.6	1.0398	6	62.39	3.895	0.5206
7.4	1.0538	8	84.30	5.263	0.7035
9.3	1.0681	10	106.8	6.668	0.8914
11.1	1.0826	12	129.9	8.110	1.084
12.9	1.0975	14	153.7	9.592	1.282
14.7	1.1128	16	178.0	11.12	1.486
16.5	1.1285	18	203.1	12.68	1.695
18.3	1.1447	20	228.9	14.29	1.911
20.2	1.1614	22	255.5	15.95	2.132
22.0	1.1785	24	282.8	17.66	2.360
23.8	1.1961	26	311.0	19.41	2.595
25.6	1.2143	28	340.0	21.23	2.837
27.4	1.2331	30	369.9	23.09	3.087
32.0	1.2829	35	449.0	28.03	3.747
36.6	1.3370	40	534.8	33.39	4.463
41.1	1.3959	45	628.2	39.21	5.242
45.7	1.4602	50	730.1	45.58	6.093
50.3	1.5304	55	841.7	52.55	7.024
54.8	1.6070	60	964.2	60.19	8.046
59.2	1.6904	65	1099	68.59	9.169
63.6	1.7811	70	1247	77.83	10.40

Bé.	Sp. gr.	Per cent As_2O_5	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.8	1.0057	0.810	8.143	0.5083	0.0680
1.8	1.0124	1.62	16.39	1.023	0.1368
3.7	1.0260	3.24	33.23	2.074	0.2773
5.6	1.0398	4.86	50.51	3.153	0.4216
7.4	1.0538	6.48	68.26	4.261	0.5696
9.3	1.0681	8.10	86.48	5.399	0.7217
11.1	1.0826	9.72	105.2	6.566	0.8778
12.9	1.0975	11.3	124.4	7.766	1.038
14.7	1.1128	13.0	144.2	8.999	1.203
16.5	1.1285	14.6	164.5	10.27	1.373
18.3	1.1447	16.2	185.4	11.57	1.547
20.2	1.1614	17.8	206.9	12.91	1.726
22.0	1.1785	19.4	229.0	14.30	1.911
23.8	1.1961	21.1	251.8	15.72	2.101
25.6	1.2143	22.7	275.3	17.19	2.297
27.4	1.2331	24.3	299.5	18.70	2.500
32.0	1.2829	28.3	363.6	22.70	3.034
36.6	1.3370	32.4	433.0	27.03	3.614
41.1	1.3959	36.4	508.6	31.75	4.244
45.7	1.4602	40.5	591.1	36.90	4.933
50.3	1.5304	44.5	681.5	42.54	5.687
54.8	1.6070	48.6	780.7	48.74	6.515
59.2	1.6904	52.6	889.6	55.54	7.424
63.6	1.7811	56.7	1009	63.02	8.424

BARIUM CHLORIDE

SPECIFIC GRAVITY OF AQUEOUS BARIUM CHLORIDE SOLUTIONS AT $\frac{20°}{4°}$ C.*

Bé.	Sp. gr.	Per cent $BaCl_2$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
2.3	1.0159	2	20.32	1.268	0.1696
4.8	1.0341	4	41.36	2.582	0.3452
7.3	1.0528	6	63.17	3.943	0.5272
9.8	1.0721	8	85.77	5.354	0.7158
12.2	1.0921	10	109.2	6.818	0.9114
14.7	1.1128	12	133.5	8.336	1.114
17.2	1.1342	14	158.8	9.913	1.325
19.6	1.1564	16	185.0	11.55	1.544
22.0	1.1793	18	212.3	13.25	1.771
24.5	1.2031	20	240.6	15.02	2.008
26.9	1.2277	22	270.1	16.86	2.254
29.3	1.2531	24	300.7	18.77	2.510
31.7	1.2793	26	332.6	20.76	2.776

Bé.	Sp. gr.	Per cent $BaCl_2 + 2H_2O$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
2.3	1.0159	2.346	23.83	1.488	0.1989
4.8	1.0341	4.692	48.52	3.029	0.4049
7.3	1.0528	7.038	74.10	4.626	0.6184
9.8	1.0721	9.384	100.6	6.281	0.8396
12.2	1.0921	11.73	128.1	7.997	1.069
14.7	1.1128	14.08	156.6	9.778	1.307
17.2	1.1342	16.42	186.3	11.63	1.554
19.6	1.1564	18.77	217.0	13.55	1.811
22.0	1.1793	21.11	249.0	15.54	2.078
24.5	1.2031	23.46	282.2	17.62	2.355
26.9	1.2277	25.81	316.8	19.78	2.644
29.3	1.2531	28.15	352.8	22.02	2.944
31.7	1.2793	30.50	390.2	24.36	3.256

CADMIUM NITRATE

Specific Gravity of Aqueous Cadmium Nitrate Solutions at $\frac{18°}{4°}$ C.*

Bé.	Sp. gr.	Per cent $Cd(NO_3)_2$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
2.2	1.0154	2	20.31	1.268	0.1695
4.6	1.0326	4	41.30	2.578	0.3447
6.9	1.0502	6	63.01	3.934	0.5259
9.3	1.0683	8	85.46	5.335	0.7132
11.6	1.0869	10	108.7	6.785	0.9070
13.9	1.1061	12	132.7	8.286	1.108
16.2	1.1261	14	157.7	9.842	1.316
18.6	1.1468	16	183.5	11.45	1.531
20.9	1.1682	18	210.3	13.13	1.755
23.2	1.1904	20	238.1	14.86	1.987
28.9	1.2488	25	312.2	19.50	2.605
34.5	1.3124	30	393.7	24.58	3.286
40.1	1.3822	35	483.8	30.20	4.037
45.6	1.4590	40	583.6	36.43	4.870
51.1	1.5438	45	694.7	43.37	5.797
56.4	1.6356	50	817.8	51.05	6.825

CALCIUM CHLORIDE

Specific Gravity of Aqueous Calcium Chloride Solutions at $\frac{20°}{4°}$ C.*

Bé.	Sp. gr.	Per cent $CaCl_2$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
2.1	1.0148	2	20.30	1.267	0.1694
4.4	1.0316	4	41.26	2.576	0.3444
6.7	1.0486	6	62.92	3.928	0.5251
9.0	1.0659	8	85.27	5.323	0.7116
11.2	1.0835	10	108.4	6.764	0.9042
13.4	1.1015	12	132.2	8.252	1.103
15.5	1.1198	14	156.8	9.787	1.308
17.7	1.1386	16	182.2	11.37	1.520
19.8	1.1578	18	208.4	13.01	1.739
21.9	1.1775	20	235.5	14.70	1.965
27.0	1.2284	25	307.1	19.17	2.563
31.9	1.2816	30	384.5	24.00	3.209
36.6	1.3373	35	468.1	29.22	3.906
41.1	1.3957	40	558.3	34.85	4.659

Bé.	Sp. gr.	Per cent $CaCl_2 + 6H_2O$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
2.1	1.0148	3.948	40.06	2.501	0.3343
4.4	1.0316	7.896	81.46	5.085	0.6800
6.7	1.0486	11.84	124.2	7.753	1.036
9.0	1.0659	15.79	168.3	10.51	1.405
11.2	1.0835	19.74	213.9	13.35	1.785
13.4	1.1015	23.69	260.9	16.29	2.177
15.5	1.1198	27.64	309.5	19.32	2.583
17.7	1.1386	31.58	359.6	22.45	3.001
19.8	1.1578	35.53	411.4	25.68	3.433
21.9	1.1775	39.48	465.9	29.02	3.879
27.0	1.2284	49.35	606.2	37.84	5.059
31.9	1.2816	59.22	759.0	47.38	6.334
36.6	1.3373	69.09	923.9	57.68	7.710
41.1	1.3957	78.96	1102.0	68.80	9.197

CHROMIC ACID

Specific Gravity of Aqueous Chromic Acid Solutions at $\frac{15°}{4°}$ C.*

Bé.	Sp. gr.	Per cent CrO_3	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.9	1.006	1	10.06	0.6280	0.0840
2.0	1.014	2	20.28	1.266	0.1692
4.2	1.030	4	41.20	2.572	0.3438
6.2	1.045	6	62.70	3.914	0.5232
8.2	1.060	8	84.80	5.294	0.7077
10.2	1.076	10	107.6	6.717	0.8979
12.3	1.093	12	131.2	8.188	1.095
14.4	1.110	14	155.4	9.701	1.297
16.3	1.127	16	180.3	11.26	1.505
18.4	1.145	18	206.1	12.87	1.720
20.3	1.163	20	232.6	14.52	1.941
22.2	1.181	22	259.8	16.22	2.168
24.2	1.200	24	288.0	17.98	2.403
26.2	1.220	26	317.2	19.80	2.647
28.1	1.240	28	347.2	21.67	2.897
29.9	1.260	30	378.0	23.60	3.154
34.6	1.313	35	459.6	28.69	3.835
39.2	1.371	40	548.4	34.24	4.577
44.0	1.435	45	645.8	40.31	5.389
48.7	1.505	50	752.5	46.98	6.280
53.3	1.581	55	869.6	54.28	7.257
57.8	1.663	60	997.8	62.29	8.327

CHROMIUM SULFATE

Specific Gravity of Aqueous Chromium Sulfate Solutions at $\frac{15°}{4°}$ C.*

Bé.	Sp. gr.	Per cent $Cr_2(SO_4)_3$ (green)	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.2	1.0081	1	10.08	0.6293	0.0841
2.5	1.0172	2	20.34	1.270	0.1698
5.0	1.0358	4	41.43	2.586	0.3458
7.6	1.0551	6	63.31	3.952	0.5283
10.1	1.0751	8	86.01	5.369	0.7178
12.7	1.0958	10	109.6	6.841	0.9145
15.2	1.1172	12	134.1	8.369	1.119
17.7	1.1392	14	159.5	9.956	1.331
20.2	1.1618	16	185.9	11.60	1.551
22.7	1.1851	18	213.3	13.32	1.780
25.1	1.2091	20	241.8	15.10	2.018
27.5	1.2339	22	271.5	16.95	2.265
29.9	1.2594	24	302.3	18.87	2.522
32.2	1.2856	26	334.3	20.87	2.789
34.5	1.3125	28	367.5	22.94	3.067
36.8	1.3401	30	402.0	25.10	3.355
42.3	1.4123	35	494.3	30.86	4.125
47.6	1.4893	40	595.7	37.19	4.971

Bé.	Sp. gr.	Per cent $Cr_2(SO_4)_3$ (violet)	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.3	1.0091	1	10.09	0.6300	0.084
2.7	1.0191	2	20.38	1.272	0.1701
5.5	1.0395	4	41.58	2.596	0.3470
8.3	1.0604	6	63.62	3.972	0.5310
11.0	1.0817	8	86.54	5.402	0.7222
13.6	1.1034	10	110.3	6.888	0.9208
16.2	1.1257	12	135.1	8.433	1.127
18.8	1.1486	14	160.8	10.04	1.342
21.3	1.1722	16	187.6	11.71	1.565
23.8	1.1966	18	215.4	13.45	1.797
26.3	1.2218	20	244.4	15.25	2.039
28.8	1.2479	22	274.5	17.14	2.291
31.3	1.2750	24	306.0	19.10	2.554
33.7	1.3032	26	338.8	21.15	2.828
36.2	1.3325	28	373.1	23.29	3.114

CITRIC ACID

Specific Gravity of Citric Acid Solutions at 15° C. (Gerlach)

Bé.	Sp. gr.	Per cent $C_6H_8O_7 + H_2O$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.1	1.0074	2	20.15	1.258	0.1681
2.1	0.0149	4	40.60	2.534	0.3388
3.2	0.0227	6	61.36	3.831	0.5121
4.3	0.0309	8	82.47	5.148	0.6883
5.5	0.0392	10	103.9	6.487	0.8672
6.5	0.0470	12	125.6	7.843	1.048
7.6	0.0549	14	147.7	9.220	1.232
8.6	0.0632	16	170.1	10.62	1.420
9.7	0.0718	18	192.9	12.04	1.610
10.8	0.0805	20	216.1	13.49	1.803
11.8	0.0889	22	239.6	14.95	1.999
12.8	0.0972	24	263.3	16.44	2.198
13.9	0.1060	26	287.6	17.95	2.400
15.0	0.1152	28	312.3	19.49	2.606
16.0	0.1244	30	337.3	21.06	2.815
17.1	0.1333	32	362.7	22.64	3.026
18.1	0.1422	34	388.3	24.24	3.241
19.1	0.1515	36	414.5	25.88	3.459
20.1	0.1612	38	441.3	27.55	3.682
21.2	0.1709	40	468.4	29.24	3.909
22.3	0.1814	42	496.2	30.98	4.141
23.1	0.1899	44	523.6	32.68	4.369
24.2	0.1998	46	551.9	34.45	4.606
25.2	0.2103	48	580.9	36.27	4.848
26.2	0.2204	50	610.2	38.09	5.092
27.2	0.2307	52	640.0	39.95	5.341
28.2	0.2410	54	670.1	41.83	5.592
29.1	0.2514	56	700.8	43.75	5.848
30.2	0.2627	58	732.4	45.72	6.112
31.2	0.2738	60	764.3	47.71	6.378
32.2	0.2849	62	796.6	49.73	6.648
33.1	0.2960	64	829.4	51.78	6.922
34.1	0.3071	66	862.7	53.85	7.199

COPPER NITRATE

SPECIFIC GRAVITY OF AQUEOUS CUPRIC NITRATE SOLUTIONS AT $\frac{20°}{4°}$ C.*

Bé.	Sp. gr.	Per cent $Cu(NO_3)_2$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.0	1.007	1	10.07	0.6286	0.0840
2.1	1.015	2	20.30	1.267	0.1694
4.5	1.032	4	41.28	2.577	0.3445
6.9	1.050	6	63.00	3.933	0.5258
9.4	1.069	8	85.52	5.339	0.7137
11.7	1.088	10	108.8	6.792	0.9080
14.0	1.107	12	132.8	8.293	1.109
16.2	1.126	14	157.6	9.841	1.316
18.6	1.147	16	183.5	11.46	1.532
20.9	1.168	18	210.2	13.12	1.754
23.1	1.189	20	237.8	14.85	1.984
28.8	1.248	25	312.0	19.48	2.604

COPPER SULFATE

SPECIFIC GRAVITY OF AQUEOUS COPPER SULFATE SOLUTIONS AT $\frac{20°}{4°}$ C.*

Bé.	Sp. gr.	Per cent $CuSO_4$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.3	1.009	1	10.09	0.6299	0.0842
2.7	1.019	2	20.38	1.272	0.1701
5.6	1.040	4	41.60	2.597	0.3472
8.5	1.062	6	63.72	3.978	0.5318
11.2	1.084	8	86.72	5.414	0.7237
14.0	1.107	10	110.7	6.911	0.9238
16.8	1.131	12	135.7	8.473	1.133
19.4	1.154	14	161.6	10.09	1.348
22.1	1.180	16	188.8	11.79	1.576
24.8	1.206	18	217.1	13.55	1.812

COPPER SULFATE (Continued)

Specific Gravity of Aqueous Copper Sulfate Solutions at $\frac{20°}{4°}$ C.*

Bé.	Sp. gr.	Per cent $CuSO_4 + 5H_2O$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.3	1.009	1.564	15.78	0.9853	0.1317
2.7	1.019	3.129	31.88	1.990	0.2661
5.6	1.040	6.257	65.07	4.062	0.5431
8.5	1.062	9.386	99.68	6.223	0.8318
11.2	1.084	12.51	135.7	8.469	1.132
14.0	1.107	15.64	173.2	10.81	1.445
16.8	1.131	18.77	212.3	13.25	1.772
19.4	1.154	21.90	252.7	15.78	2.110
22.1	1.180	25.03	295.3	18.44	2.465
24.8	1.206	28.16	339.6	21.20	2.834

Specific Gravity of Aqueous Copper Sulfate Solutions at 18° C. (Schiff and Gerlach)

Bé.	Sp. gr.	Per cent $CuSO_4$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.9	1.0063	0.6393	6.433	0.4016	0.0537
1.8	1.0126	1.279	12.95	0.8082	0.1080
2.7	1.0190	1.918	19.54	1.220	0.1631
3.6	1.0254	2.557	26.22	1.637	0.2188
4.5	1.0319	3.196	32.98	2.059	0.2753
5.4	1.0384	3.836	39.83	2.486	0.3324
6.2	1.0450	4.475	46.76	2.919	0.3902
7.1	1.0516	5.114	53.78	3.357	0.4488
8.0	1.0582	5.753	60.88	3.801	0.5081
8.8	1.0649	6.393	68.08	4.250	0.5681
9.7	1.0716	7.032	75.35	4.704	0.6289
10.6	1.0785	7.671	82.73	5.165	0.6904
11.4	1.0854	8.311	90.20	5.631	0.7528
12.3	1.0923	8.950	97.76	6.103	0.8158
13.1	1.0993	9.589	105.4	6.581	0.8797
13.9	1.1063	10.23	113.2	7.064	0.9443
14.8	1.1135	10.87	121.0	7.554	1.010
15.6	1.1208	11.51	129.0	8.051	1.076
16.5	1.1281	12.15	137.0	8.554	1.143
17.3	1.1354	12.79	145.2	9.062	1.211
18.1	1.1427	13.42	153.4	9.577	1.280
18.9	1.1501	14.06	161.7	10.10	1.350
19.8	1.1585	14.70	170.3	10.63	1.421

COPPER SULFATE (Continued)

Specific Gravity of Aqueous Copper Sulfate Solutions at 19° C. (Schiff and Gerlach)

Bé.	Sp. gr.	Per cent $CuSO_4$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
20.6	1.1659	15.34	178.9	11.17	1.493
21.5	1.1738	15.98	187.6	11.71	1.566
22.3	1.1817	16.62	196.4	12.26	1.639
23.1	1.1898	17.26	205.4	12.82	1.714
24.0	1.1980	17.90	214.4	13.39	1.790
24.8	1.2063	18.54	223.6	13.96	1.866
25.6	1.2146	19.18	232.9	14.54	1.944

Specific Gravity of Aqueous Copper Sulfate Solutions at 18° C. (Schiff and Gerlach)

Bé.	Sp. gr.	Per cent $CuSO_4 + 5H_2O$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.9	1.0063	1	10.06	0.6282	0.0840
1.8	1.0126	2	20.25	1.264	0.1690
2.7	1.0190	3	30.57	1.908	0.2551
3.6	1.0254	4	41.02	2.561	0.3423
4.5	1.0319	5	51.60	3.221	0.4306
5.4	1.0384	6	62.30	3.889	0.5199
6.2	1.0450	7	73.15	4.567	0.6105
7.1	1.0516	8	84.13	5.252	0.7021
8.0	1.0582	9	95.24	5.945	0.7948
8.8	1.0649	10	106.5	6.648	0.8887
9.7	1.0716	11	117.9	7.359	0.9837
10.6	1.0785	12	129.4	8.079	1.080
11.4	1.0854	13	141.1	8.809	1.178
12.3	1.0923	14	152.9	9.546	1.276
13.1	1.0993	15	164.9	10.29	1.376
13.9	1.1063	16	177.0	11.05	1.477
14.8	1.1135	17	189.3	11.82	1.580
15.6	1.1208	18	201.7	12.59	1.684
16.5	1.1281	19	214.3	13.38	1.789
17.3	1.1354	20	227.1	14.18	1.895
18.1	1.1427	21	240.0	14 98	2.003
18.9	1.1501	22	253.0	15 80	2.112
19.8	1.1585	23	266.5	16.63	2.224
20.6	1.1659	24	279.8	17.47	2.335
21.5	1.1738	25	293.5	18.32	2.449
22.3	1.1817	26	307.2	19.18	2.564
23.1	1.1898	27	321.2	20.05	2.681
24.0	1.1980	28	335.4	20.94	2.799
24.8	1.2063	29	349.8	21.84	2.919
25.6	1.2146	30	364.4	22.75	3.041

CUPRIC CHLORIDE

Specific Gravity of Aqueous Cupric Chloride Solutions at $\frac{20°}{4°}$ C.*

Bé.	Sp. gr.	Per cent $CuCl_2$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.0	1.007	1	10.07	0.6286	0.0840
2.4	1.017	2	20.34	1.270	0.1697
5.0	1.036	4	41.44	2.587	0.3458
7.7	1.056	6	63.36	3.955	0.5288
10.1	1.075	8	86.00	5.369	0.7177
12.7	1.096	10	109.6	6.842	0.9146
15.2	1.117	12	134.0	8.368	1.119
17.6	1.138	14	159.3	9.946	1.330
20.0	1.160	16	185.6	11.59	1.549
22.3	1.182	18	212.8	13.28	1.776
24.7	1.205	20	241.0	15.04	2.011

Specific Gravity of Aqueous Cupric Chloride Solutions at 17.5° C. (Franz)

Bé.	Sp. gr.	Per cent $CuCl_2$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.3	1.0091	1	10.09	0.6300	0.0842
2.6	1.0182	2	20.36	1.271	0.1699
3.9	1.0273	3	30.82	1.924	0.2572
5.1	1.0364	4	41.46	2.588	0.3460
6.3	1.0455	5	52.28	3.263	0.4363
7.5	1.0548	6	63.29	3.951	0.5282
8.7	1.0641	7	74.49	4.650	0.6216
9.9	1.0734	8	85.87	5.361	0.7166
11.1	1.0827	9	97.44	6.083	0.8132
12.2	1.0920	10	109.2	6.817	0.9113
13.8	1.1049	11	121.5	7.587	1.014
15.3	1.1178	12	134.1	8.374	1.119
16.8	1.1307	13	147.0	9.176	1.227
18.2	1.1436	14	160.1	9.995	1.336
19.6	1.1565	15	173.5	10.83	1.448
21.0	1.1696	16	187.1	11.68	1.562
22.4	1.1827	17	201.1	12.55	1.678
23.7	1.1958	18	215.2	13.44	1.796
25.1	1.2089	19	229.7	14.34	1.917
26.4	1.2223	20	244.5	15.26	2.040
27.7	1.2362	21	259.6	16.21	2.166
29.0	1.2501	22	275.0	17.17	2.295

CUPRIC CHLORIDE (Continued)

SPECIFIC GRAVITY OF AQUEOUS CUPRIC CHLORIDE SOLUTIONS AT 17.5° C. (FRANZ)

Bé.	Sp. gr.	Per cent $CuCl_2$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
30.3	1.2640	23	290.7	18.15	2.426
31.5	1.2779	24	306.7	19.15	2.559
32.8	1.2918	25	323.0	20.16	2.695
34.0	1.3058	26	339.5	21.19	2.833
35.1	1.3198	27	356.3	22.25	2.974
36.3	1.3338	28	373.4	23.31	3.117
37.4	1.3478	29	390.9	24.40	3.262
38.5	1.3618	30	408.5	25.50	3.409
39.8	1.3784	31	427.3	26.68	3.566
41.1	1.3950	32	446.4	27.87	3.725
42.3	1.4116	33	465.8	29.08	3.887
43.5	1.4287	34	485.8	30.32	4.054
44.6	1.4447	35	505.6	31.57	4.220
45.8	1.4615	36	526.1	32.85	4.391
46.9	1.4782	37	546.9	34.14	4.564
48.0	1.4949	38	568.1	35.46	4.741
49.1	1.5116	39	589.5	36.80	4.920
50.1	1.5284	40	611.4	38.17	5.102

FERRIC CHLORIDE

SPECIFIC GRAVITY OF AQUEOUS FERRIC CHLORIDE SOLUTIONS AT $\frac{20°}{4°}$ C.*

Bé.	Sp. gr.	Per cent $FeCl_3$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.0	1.007	1	10.07	0.6286	0.0840
2.1	1.015	2	20.30	1.267	0.1694
4.5	1.032	4	41.28	2.577	0.3445
6.8	1.049	6	62.94	3.929	0.5253
9.1	1.067	8	85.36	5.329	0.7124
11.4	1.085	10	108.5	6.773	0.9055
13.7	1.104	12	132.5	8.270	1.106
15.9	1.123	14	157.2	9.815	1.312
18.0	1.142	16	182.7	11.41	1.525
20.2	1.162	18	209.2	13.06	1.745
22.3	1.182	20	236.4	14.76	1.973
27.5	1.234	25	308.5	19.26	2.574
32.7	1.291	30	387.3	24.18	3.232
37.8	1.353	35	473.6	29.56	3.952
42.7	1.418	40	567.2	35.41	4.733
47.4	1.485	45	668.3	41.72	5.577
51.5	1.551	50	775.5	48.41	6.472

FERRIC CHLORIDE

Specific Gravity of Aqueous Ferric Chloride Solutions at 17.5° C. (Franz)

Bé.	Sp. gr.	Per cent Fe_2Cl_6	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.1	1.0073	1	10.07	0.6288	0.0841
2.1	1.0146	2	20.29	1.267	0.1693
3.1	1.0219	3	30.66	1.914	0.2558
4.1	1.0292	4	41.17	2.570	0.3436
5.1	1.0365	5	51.83	3.235	0.4325
6.1	1.0439	6	62.63	3.910	0.5227
7.0	1.0513	7	73.59	4.594	0.6141
8.0	1.0587	8	84.70	5.287	0.7068
9.0	1.0661	9	95.95	5.990	0.8007
9.9	1.0734	10	107.3	6.701	0.8958
10.9	1.0814	11	119.0	7.426	0.9927
11.9	1.0894	12	130.7	8.161	1.091
12.9	1.0974	13	142.7	8.906	1.191
13.8	1.1054	14	154.8	9.661	1.291
14.8	1.1134	15	167.0	10.43	1.394
15.7	1.1215	16	179.4	11.20	1.497
16.6	1.1297	17	192.0	11.99	1.603
17.6	1.1378	18	204.8	12.79	1.709
18.4	1.1458	19	217.7	13.59	1.817
19.4	1.1542	20	230.8	14.41	1.926
20.5	1.1644	21	244.5	15.26	2.041
21.6	1.1746	22	258.4	16.13	2.157
22.6	1.1848	23	272.5	17.01	2.274
23.7	1.1950	24	286.8	17.90	2.393
24.7	1.2052	25	301.3	18.81	2.514
25.7	1.2155	26	316.0	19.73	2.637
26.7	1.2258	27	331.0	20.66	2.762
27.7	1.2365	28	346.2	21.61	2.889
28.7	1.2464	29	361.5	22.56	3.016
29.6	1.2568	30	377.0	23.54	3.146
30.6	1.2673	31	392.9	24.53	3.279
31.5	1.2778	32	408.9	25.53	3.412
32.5	1.2883	33	425.1	26.54	3.548
33.4	1.2988	34	441.6	27.57	3.685
34.3	1.3093	35	458.3	28.61	3.824
35.1	1.3199	36	475.2	29.66	3.965
36.0	1.3305	37	492.3	30.73	4.108
36.9	1.3411	38	509.6	31.81	4.253
37.7	1.3517	39	527.2	32.91	4.399
38.6	1.3622	40	544.9	34.02	4.547
39.5	1.3746	41	563.6	35.18	4.703
40.5	1.3870	42	582.5	36.37	4.861

FERRIC CHLORIDE (Continued)

SPECIFIC GRAVITY OF AQUEOUS FERRIC CHLORIDE SOLUTIONS AT 17.5° C. (FRANZ)

Bé.	Sp. gr.	Per cent Fe_2Cl_6	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
41.4	1.3994	43	601.7	37.56	5.022
42.3	1.4118	44	621.2	38.78	5.184
43.2	1.4242	45	640.9	40.01	5.348
44.1	1.4367	46	660.9	41.26	5.515
44.9	1.4492	47	681.1	42.52	5.684
45.8	1.4617	48	701.6	43.80	5.855
46.6	1.4742	49	722.4	45.09	6.028
47.5	1.4867	50	743.4	46.41	6.203
48.4	1.5010	51	765.5	47.79	6.388
49.3	1.5153	52	788.0	49.19	6.576
50.2	1.5296	53	810.7	50.61	6.765
51.1	1.5439	54	833.7	52.05	6.957
51.9	1.5582	55	857.0	53.50	7.152
52.8	1.5729	56	880.8	54.99	7.351
53.7	1.5876	57	904.9	56.49	7.552
54.5	1.6023	58	929.3	58.02	7.755
55.3	1.6170	59	954.0	59.56	7.962
56.1	1.6317	60	979.0	61.12	8.170

FERRIC NITRATE

SPECIFIC GRAVITY OF AQUEOUS FERRIC NITRATE SOLUTIONS AT $\frac{18°}{4°}$ C.*

Bé.	Sp. gr.	Per cent $Fe(NO_3)_3$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.9	1.0065	1	10.07	0.6283	0.0840
2.1	1.0144	2	20.29	1.267	0.1693
4.3	1.0304	4	41.22	2.573	0.3440
6.5	1.0468	6	62.81	3.921	0.5242
8.7	1.0636	8	85.09	5.312	0.7101
10.9	1.0810	10	108.1	6.748	0.9021
13.1	1.0989	12	131.9	8.232	1.101
15.2	1.1172	14	156.4	9.764	1.305
17.3	1.1359	16	181.7	11.35	1.517
19.5	1.1551	18	207.9	12.98	1.735
21.6	1.1748	20	235.0	14.67	1.961
26.9	1.2281	25	307.0	19.17	2.562

FERRIC NITRATE

SPECIFIC GRAVITY OF AQUEOUS FERRIC NITRATE SOLUTIONS AT 17.5° C. (FRANZ)

Bé.	Sp. gr.	Per cent $Fe(NO_3)_3$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.2	1.0080	1	10.08	0.6293	0.0841
2.3	1.0160	2	20.32	1.269	0.1696
3.4	1.0240	3	30.72	1.918	0.2564
4.5	1.0320	4	41.28	2.577	0.3445
5.6	1.0398	5	51.99	3.246	0.4339
6.5	1.0472	6	62.83	3.922	0.5244
7.5	1.0546	7	73.82	4.608	0.6161
8.5	1.0620	8	84.96	5.304	0.7090
9.4	1.0694	9	96.25	6.008	0.8032
10.4	1.0770	10	107.7	6.723	0.8988
11.4	1.0852	11	119.4	7.452	0.9962
12.4	1.0934	12	131.2	8.191	1.095
13.4	1.1016	13	143.2	8.940	1.195
14.3	1.1098	14	155.4	9.699	1.297
15.3	1.1182	15	167.7	10.47	1.400
16.3	1.1268	16	180.3	11.25	1.505
17.3	1.1354	17	193.0	12.05	1.611
18.3	1.1440	18	205.9	12.85	1.718
19.2	1.1526	19	219.0	13.67	1.828
20.1	1.1612	20	232.2	14.50	1.938
21.2	1.1712	21	246.0	15.35	2.053
22.2	1.1812	22	259.9	16.22	2.169
23.3	1.1912	23	274.0	17.10	2.286
24.3	1.2012	24	288.3	18.00	2.406
25.3	1.2110	25	302.8	18.90	2.527
26.3	1.2212	26	317.5	19.82	2.650
27.3	1.2314	27	332.5	20.76	2.775
28.2	1.2416	28	347.6	21.70	2.901
29.2	1.2518	29	363.0	22.66	3.029
30.1	1.2622	30	378.7	23.64	3.160
31.1	1.2730	31	394.6	24.64	3.293
32.1	1.2838	32	410.8	25.65	3.428
33.0	1.2946	33	427.2	26.67	3.565
33.9	1.3054	34	443.8	27.71	3.704
34.9	1.3164	35	460.7	28.76	3.845
35.8	1.3280	36	478.1	29.85	3.990
36.8	1.3396	37	495.7	30.94	4.136
37.7	1.3512	38	513.5	32.05	4.285
38.6	1.3628	39	531.5	33.18	4.435
39.5	1.3746	40	549.8	34.32	4.589
40.4	1.3864	41	568.4	35.49	4.744
41.3	1.3982	42	587.2	36.66	4.901

FERRIC NITRATE (Continued)

Specific Gravity of Aqueous Ferric Nitrate Solutions at 17.5° C. (Franz)

Bé.	Sp. gr.	Per cent $Fe(NO_3)_3$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
42.2	1.4100	43	606.3	37.85	5.060
43.0	1.4218	44	625.6	39.05	5.221
43.9	1.4338	45	645.2	40.28	5.384
44.8	1.4465	46	665.4	41.54	5.553
45.6	1.4592	47	685.8	42.81	5.723
46.5	1.4719	48	706.5	44.11	5.896
47.3	1.4846	49	727.5	45.41	6.071
48.2	1.4972	50	748.6	46.73	6.247
49.1	1.5122	51	771.2	48.15	6.436
50.1	1.5272	52	794.1	49.58	6.627
51.0	1.5422	53	817.4	51.03	6.821
51.9	1.5572	54	840.9	52.49	7.017
52.8	1.5722	55	864.7	53.98	7.216
53.8	1.5892	56	890.0	55.56	7.427
54.7	1.6062	57	915.5	57.15	7.640
55.7	1.6232	58	941.5	58.77	7.857
56.6	1.6402	59	967.7	60.41	8.076
57.5	1.6572	60	994.3	62.07	8.298
58.5	1.6764	61	1023	63.84	8.534
59.5	1.6956	62	1051	65.63	8.773
60.4	1.7148	63	1080	67.44	9.016
61.4	1.7340	64	1110	69.28	9.261
62.3	1.7532	65	1140	71.14	9.510

FERRIC SULFATE

Specific Gravity of Aqueous Ferric Sulfate Solutions at $\frac{17.5°}{4°}$ C.*

Bé.	Sp. gr.	Per cent $Fe_2(SO_4)_3$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.0	1.007	1	10.07	0.6286	0.0840
2.3	1.016	2	20.32	1.269	0.1696
4.7	1.033	4	41.32	2.579	0.3448
6.9	1.050	6	63.00	3.933	0.5258
9.1	1.067	8	85.36	5.329	0.7124
11.2	1.084	10	108.4	6.767	0.9046
13.5	1.103	12	132.4	8.263	1.105
15.8	1.122	14	157.1	9.806	1.311
17.9	1.141	16	182.6	11.40	1.524
20.1	1.161	18	209.0	13.05	1.744
22.2	1.181	20	236.2	14.75	1.971
28.2	1.241	25	310.3	19.37	2.590
34.1	1.307	30	392.1	24.48	3.272
39.6	1.376	35	481.6	30.06	4.019
44.9	1.449	40	579.6	36.18	4.837
50.1	1.528	45	687.6	42.92	5.738
55.1	1.613	50	806.5	50.35	6.730
59.9	1.703	55	936.7	58.47	7.817
64.4	1.798	60	1079	67.35	9.003

FERROUS SULFATE

Specific Gravity of Aqueous Ferrous Sulfate Solutions at $\frac{18°}{4°}$ C.*

Bé.	Sp. gr.	Per cent $FeSO_4$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.1	1.0007	0.2	2.001	0.1249	0.0167
0.4	1.0028	0.4	4.011	0.2504	0.0335
0.7	1.0046	0.6	6.028	0.3763	0.0503
0.9	1.0065	0.8	8.052	0.5027	0.0672
1.2	1.0085	1.0	10.09	0.6296	0.0842
2.6	1.0180	2	20.36	1.271	0.1699
5.2	1.0375	4	41.50	2.591	0.3463
7.9	1.0575	6	63.45	3.961	0.5295
10.6	1.0785	8	86.28	5.386	0.7200
13.2	1.1000	10	110.0	6.867	0.9180
15.8	1.1220	12	134.6	8.405	1.124
18.3	1.1445	14	160.2	10.00	1.337
20.8	1.1675	16	186.8	11.66	1.559
23.2	1.1905	18	214.3	13.38	1.788
25.5	1.2135	20	242.7	15.15	2.025

Bé.	Sp. gr.	Per cent $FeSO_4 + 7H_2O$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.1	1.0007	0.366	3.663	0.2287	0.0306
0.4	1.0028	0.732	7.341	0.4583	0.0613
0.7	1.0046	1.10	11.03	0.6887	0.0921
0.9	1.0065	1.46	14.74	0.9200	0.1230
1.2	1.0085	1.83	18.46	1.152	0.1540
2.6	1.0180	3.66	37.26	2.326	0.3110
5.2	1.0375	7.32	75.95	4.742	0.6339
7.9	1.0575	11.0	116.1	7.249	0.9691
10.6	1.0785	14.6	157.9	9.858	1.318
13.2	1.1000	18.3	201.3	12.57	1.680
15.8	1.1220	22.0	246.4	15.38	2.056
18.3	1.1445	25.6	293.3	18.31	2.447
20.8	1.1675	29.3	341.9	21.34	2.853
23.2	1.1905	32.9	392.2	24.48	3.273
25.5	1.2135	36.6	444.2	27.73	3.707

FORMIC ACID

Specific Gravity of Aqueous Formic Acid Solutions at $\frac{20°}{4°}$ C.*

Bé.	Sp. gr.	Per cent HCO_2H	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
....	0.9982	0	.....	.....	.....
0.3	1.0019	1	10.02	0.6255	0.0836
0.6	1.0044	2	20.09	1.254	0.1676
1.0	1.0070	3	30.21	1.886	0.2521
1.3	1.0093	4	40.37	2.520	0.3369
1.6	1.0115	5	50.58	3.157	0.4221
2.0	1.0141	6	60.85	3.798	0.5078
2.4	1.0170	7	71.19	4.444	0.5941
2.8	1.0196	8	81.57	5.092	0.6807
3.1	1.0221	9	91.99	5.743	0.7677
3.5	1.0246	10	102.5	6.396	0.8551
3.8	1.0271	11	113.0	7.053	0.9429
4.2	1.0296	12	123.6	7.713	1.031
4.5	1.0321	13	134.2	8.376	1.120
4.8	1.0345	14	144.8	9.041	1.209
5.2	1.0370	15	155.6	9.711	1.298
5.5	1.0393	16	166.3	10.38	1.388
5.8	1.0417	17	177.1	11.06	1.478
6.1	1.0441	18	187.9	11.73	1.568
6.4	1.0464	19	198.8	12.41	1.659
6.8	1.0488	20	209.8	13.09	1.750
7.1	1.0512	21	220.8	13.78	1.842
7.4	1.0537	22	231.8	14.47	1.935
7.7	1.0561	23	242.9	15.16	2.027
8.0	1.0585	24	254.0	15.86	2.120
8.3	1.0609	25	265.2	16.56	2.213
8.6	1.0633	26	276.5	17.26	2.307
8.9	1.0656	27	287.7	17.96	2.401
9.3	1.0681	28	299.1	18.67	2.496
9.6	1.0705	29	310.4	19.38	2.591
9.9	1.0729	30	321.9	20.09	2.686
10.2	1.0753	31	333.3	20.81	2.782
10.5	1.0777	32	344.9	21.53	2.878
10.7	1.0800	33	356.4	22.25	2.974
11.0	1.0823	34	368.0	22.97	3.071
11.3	1.0847	35	379.6	23.70	3.168
11.6	1.0871	36	391.4	24.43	3.266
11.9	1.0895	37	403.1	25.17	3.364
12.2	1.0919	38	414.9	25.90	3.463
12.5	1.0940	39	426.7	26.64	3.561
12.7	1.0963	40	438.5	27.38	3.660
13.1	1.0990	41	450.6	28.13	3.760
13.4	1.1015	42	462.6	28.88	3.861
13.6	1.1038	43	474.6	29.63	3.961
13.9	1.1062	44	486.7	30.38	4.062
14.2	1.1085	45	498.8	31.14	4.163
14.5	1.1108	46	511.0	31.90	4.264
14.7	1.1130	47	523.1	32.66	4.365
15.0	1.1157	48	535.5	33.43	4.469
15.4	1.1185	49	548.1	34.21	4.574
15.6	1.1207	50	560.4	34.98	4.676
15.8	1.1223	51	572.4	35.73	4.777
16.0	1.1244	52	584.7	36.50	4.879
16.3	1.1269	53	597.3	37.28	4.984
16.6	1.1295	54	609.9	38.08	5.090

FORMIC ACID (Continued)

Specific Gravity of Aqueous Formic Acid Solutions at $\frac{20°}{4°}$ C.*

Bé.	Sp. gr.	Per cent HCO_2H	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
16.9	1.1320	55	622.6	38.87	5.196
17.2	1.1342	56	635.2	39.65	5.300
17.4	1.1361	57	647.6	40.43	5.404
17.6	1.1381	58	660.1	41.21	5.509
17.8	1.1401	59	672.7	41.99	5.613
18.1	1.1424	60	685.4	42.79	5.720
18.3	1.1448	61	698.3	43.59	5.828
18.6	1.1473	62	711.3	44.41	5.936
18.8	1.1493	63	724.1	45.20	6.042
19.1	1.1517	64	737.1	46.01	6.151
19.4	1.1543	65	750.3	46.84	6.261
19.6	1.1565	66	763.3	47.65	6.370
19.8	1.1584	67	776.1	48.45	6.477
20.0	1.1604	68	789.1	49.26	6.585
20.3	1.1628	69	802.3	50.09	6.696
20.6	1.1655	70	815.9	50.93	6.808
20.8	1.1677	71	829.1	51.76	6.919
21.1	1.1702	72	842.5	52.60	7.031
21.4	1.1728	73	856.1	53.45	7.145
21.6	1.1752	74	869.6	54.29	7.257
21.8	1.1769	75	882.7	55.10	7.366
22.0	1.1785	76	895.7	55.91	7.474
22.1	1.1801	77	908.7	56.73	7.583
22.3	1.1818	78	921.8	57.55	7.693
22.5	1.1837	79	935.1	58.38	7.804
22.7	1.1860	80	948.8	59.23	7.918
22.9	1.1876	81	962.0	60.05	8.028
23.1	1.1896	82	975.5	60.90	8.141
23.3	1.1914	83	988.9	61.73	8.252
23.5	1.1929	84	1002	62.55	8.362
23.7	1.1953	85	1016	63.43	8.479
23.9	1.1976	86	1030	64.30	8.595
24.1	1.1994	87	1043	65.14	8.708
24.3	1.2012	88	1057	65.99	8.821
24.5	1.2028	89	1070	66.83	8.933
24.6	1.2044	90	1084	67.67	9.046
24.8	1.2059	91	1097	68.51	9.158
25.0	1.2078	92	1111	69.37	9.273
25.2	1.2099	93	1125	70.24	9.390
25.3	1.2117	94	1139	71.10	9.505
25.6	1.2140	95	1153	72.00	9.625
25.7	1.2158	96	1167	72.86	9.740
25.9	1.2170	97	1180	73.69	9.851
26.0	1.2183	98	1194	74.53	9.964
26.2	1.2202	99	1208	75.41	10.08
26.3	1.2212	100	1221	76.24	10.19

GLYCEROL

Specific Gravity of Aqueous Glycerol (Glycerin) Solutions at $\frac{20°}{4°}$ C.*

Bé.	Sp. gr.	Per cent $C_3H_8O_3$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
....	0.9982	0	.....	.....	.....
0.1	1.0006	1	10.01	0.6246	0.0835
0.4	1.0030	2	20.06	1.252	0.1674
0.8	1.0053	3	30.16	1.883	0.2517
1.1	1.0077	4	40.31	2.516	0.3364
1.5	1.0101	5	50.51	3.153	0.4215
1.8	1.0125	6	60.75	3.792	0.5070
2.1	1.0149	7	71.04	4.435	0.5929
2.5	1.0173	8	81.38	5.081	0.6792
2.8	1.0197	9	91.77	5.729	0.7659
3.1	1.0221	10	102.2	6.381	0.8530
3.5	1.0246	11	112.7	7.036	0.9406
3.8	1.0271	12	123.3	7.694	1.029
4.1	1.0295	13	133.8	8.355	1.117
4.5	1.0320	14	144.5	9.019	1.206
4.8	1.0345	15	155.2	9.687	1.295
5.2	1.0370	16	165.9	10.36	1.385
5.5	1.0395	17	176.7	11.03	1.475
5.8	1.0420	18	187.6	11.71	1.565
6.2	1.0445	19	198.5	12.39	1.656
6.5	1.0470	20	209.4	13.07	1.747
6.8	1.0495	21	220.4	13.76	1.839
7.2	1.0520	22	231.4	14.45	1.931
7.5	1.0545	23	242.5	15.14	2.024
7.8	1.0571	24	253.7	15.84	2.117
8.2	1.0597	25	264.9	16.54	2.211
8.5	1.0622	26	276.2	17.24	2.305
8.8	1.0648	27	287.5	17.95	2.399
9.2	1.0674	28	298.9	18.66	2.494
9.5	1.0700	29	310.3	19.37	2.590
9.8	1.0727	30	321.8	20.09	2.686
10.2	1.0753	31	333.3	20.81	2.782
10.5	1.0780	32	345.0	21.53	2.879
10.8	1.0806	33	356.6	22.26	2.976
11.2	1.0833	34	368.3	22.99	3.074
11.5	1.0860	35	380.1	23.73	3.172
11.8	1.0887	36	391.9	24.47	3.271
12.1	1.0914	37	403.8	25.21	3.370
12.5	1.0941	38	415.8	25.95	3.470
12.8	1.0968	39	427.8	26.70	3.570
13.1	1.0995	40	439.8	27.46	3.670
13.4	1.1022	41	451.9	28.21	3.771
13.8	1.1049	42	464.1	28.97	3.873
14.1	1.1075	43	476.2	29.73	3.974
14.4	1.1102	44	488.5	30.49	4.077
14.7	1.1128	45	500.8	31.26	4.179
15.0	1.1155	46	513.1	32.03	4.282
15.3	1.1182	47	525.6	32.81	4.386
15.6	1.1209	48	538.0	33.59	4.490
16.0	1.1236	49	550.6	34.37	4.595
16.3	1.1263	50	563.2	35.16	4.700
16.6	1.1290	51	575.8	35.94	4.805
16.9	1.1317	52	588.5	36.74	4.911
17.2	1.1344	53	601.2	37.53	5.017
17.5	1.1371	54	614.0	38.33	5.124

GLYCEROL (Continued)

Specific Gravity of Aqueous Glycerol (Glycerin) Solutions at $\frac{20°}{4°}$ C.*

Bé.	Sp. gr.	Per cent $C_3H_8O_3$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
17.8	1.1398	55	626.9	39.13	5.232
18.1	1.1425	56	639.8	39.94	5.339
18.4	1.1452	57	652.8	40.75	5.447
18.7	1.1479	58	665.8	41.56	5.556
19.0	1.1506	59	678.9	42.38	5.665
19.3	1.1533	60	692.0	43.20	5.775
19.6	1.1560	61	705.2	44.02	5.885
19.9	1.1587	62	718.4	44.85	5.995
20.2	1.1614	63	731.7	45.68	6.106
20.5	1.1642	64	745.1	46.51	6.218
20.8	1.1670	65	758.6	47.35	6.330
21.0	1.1697	66	772.0	48.19	6.443
21.3	1.1724	67	785.5	49.04	6.555
21.6	1.1752	68	799.1	49.89	6.669
21.9	1.1780	69	812.8	50.74	6.783
22.2	1.1808	70	826.6	51.60	6.898
22.5	1.1836	71	840.4	52.46	7.013
22.8	1.1863	72	854.1	53.32	7.128
23.1	1.1890	73	868.0	54.18	7.243
23.3	1.1917	74	881.9	55.05	7.359
23.6	1.1944	75	895.8	55.92	7.476
23.9	1.1971	76	909.8	56.80	7.592
24.2	1.1998	77	923.8	57.67	7.710
24.4	1.2025	78	938.0	58.55	7.827
24.7	1.2052	79	952.1	59.44	7.945
25.0	1.2079	80	966.3	60.32	8.064
25.2	1.2106	81	980.6	61.22	8.183
25.5	1.2133	82	994.9	62.11	8.303
25.8	1.2160	83	1009	63.01	8.423
26.0	1.2187	84	1024	63.91	8.543
26.3	1.2214	85	1038	64.81	8.664
26.5	1.2241	86	1053	65.72	8.785
26.8	1.2268	87	1067	66.63	8.907
27.1	1.2294	88	1082	67.54	9.028
27.3	1.2320	89	1096	68.45	9.150
27.6	1.2347	90	1111	69.37	9.273
27.8	1.2374	91	1126	70.29	9.397
28.1	1.2401	92	1141	71.22	9.521
28.3	1.2428	93	1156	72.15	9.645
28.6	1.2455	94	1171	73.09	9.770
28.8	1.2482	95	1186	74.03	9.896
29.1	1.2508	96	1201	74.96	10.02
29.3	1.2534	97	1216	75.90	10.15
29.5	1.2559	98	1231	76.83	10.27
29.8	1.2584	99	1246	77.77	10.40
30.0	1.2609	100	1261	78.71	10.52

HYDROCHLORIC ACID

SPECIFIC GRAVITY OF AQUEOUS HYDROCHLORIC ACID SOLUTIONS AT $\frac{20°}{4°}$ C.*

Bé.	Sp. gr.	Per cent HCl	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.5	1.0032	1	10.03	0.6263	0.0837
1.2	1.0082	2	20.16	1.259	0.1683
2.6	1.0181	4	40.72	2.542	0.3399
3.9	1.0279	6	61.67	3.850	0.5147
5.3	1.0376	8	83.01	5.182	0.6927
6.6	1.0474	10	104.7	6.539	0.8741
7.9	1.0574	12	126.9	7.921	1.059
9.2	1.0675	14	149.5	9.330	1.247
10.4	1.0776	16	172.4	10.76	1.439
11.7	1.0878	18	195.8	12.22	1.634
12.9	1.0980	20	219.6	13.71	1.833
14.2	1.1083	22	243.8	15.22	2.035
15.4	1.1187	24	268.5	16.76	2.241
16.6	1.1290	26	293.5	18.32	2.450
17.7	1.1392	28	319.0	19.91	2.662
18.8	1.1493	30	344.8	21.52	2.877
19.9	1.1593	32	371.0	23.16	3.096
21.0	1.1691	34	397.5	24.81	3.317
22.0	1.1789	36	424.4	26.49	3.542
23.0	1.1885	38	451.6	28.19	3.769
24.0	1.1980	40	479.2	29.92	3.999

HYDROCHLORIC ACID

Authority — W. C. Ferguson

This table has been approved and adopted as a standard by the Manufacturing Chemists' Association of the United States.

Specific Gravity determinations were made at 60° F., compared with water at 60° F.

From the Specific Gravities, the corresponding degrees Baumé were calculated by the following formula:

$$\text{Baumé} = 145 - \frac{145}{\text{Sp. Gr.}}.$$

Baumé Hydrometers for use with this table must be graduated by the above formula which formula should *always* be printed on the scale.

Atomic weights from F. W. Clarke's table of 1901. O = 16.

Allowance for Temperature

10° – 15° Bé. — 1/40° Bé. or .0002 Sp. Gr. for 1° F.
15° – 22° Bé. — 1/30° Bé. or .0003 " " " 1° F.
22° – 25° Bé. — 1/28° Bé. or .00035 " " " 1° F.

Bé.°	Sp. gr.	Tw.°	Per cent HCl	Bé.°	Sp. gr.	Tw.°	Per cent HCl
1.00	1.0069	1.38	1.40	10.25	1.0761	15.22	15.22
2.00	1.0140	2.80	2.82	10.50	1.0781	15.62	15.62
3.00	1.0211	4.22	4.25	10.75	1.0801	16.02	16.01
4.00	1.0284	5.68	5.69	11.00	1.0821	16.42	16.41
5.00	1.0357	7.14	7.15	11.25	1.0841	16.82	16.81
5.25	1.0375	7.50	7.52	11.50	1.0861	17.22	17.21
5.50	1.0394	7.88	7.89	11.75	1.0881	17.62	17.61
5.75	1.0413	8.26	8.26	12.00	1.0902	18.04	18.01
6.00	1.0432	8.64	8.64	12.25	1.0922	18.44	18.41
6.25	1.0450	9.00	9.02	12.50	1.0943	18.86	18.82
6.50	1.0469	9.38	9.40	12.75	1.0964	19.28	19.22
6.75	1.0488	9.76	9.78	13.00	1.0985	19.70	19.63
7.00	1.0507	10.14	10.17	13.25	1.1006	20.12	20.04
7.25	1.0526	10.52	10.55	13.50	1.1027	20.54	20.45
7.50	1.0545	10.90	10.94	13.75	1.1048	20.96	20.86
7.75	1.0564	11.28	11.32	14.00	1.1069	21.38	21.27
8.00	1.0584	11.68	11.71	14.25	1.1090	21.80	21.68
8.25	1.0603	12.06	12.09	14.50	1.1111	22.22	22.09
8.50	1.0623	12.46	12.48	14.75	1.1132	22.64	22.50
8.75	1.0642	12.84	12.87	15.00	1.1154	23.08	22.92
9.00	1.0662	13.24	13.26	15.25	1.1176	23.52	23.33
9.25	1.0681	13.62	13.65	15.50	1.1197	23.94	23.75
9.50	1.0701	14.02	14.04	15.75	1.1219	24.38	24.16
9.75	1.0721	14.42	14.43	16.0	1.1240	24.80	24.57
10.00	1.0741	14.82	14.83	16.1	1.1248	24.96	24.73

HYDROCHLORIC ACID (Continued)

Bé.°	Sp. gr.	Tw.°	Per cent HCl	Bé.°	Sp. gr.	Tw.°	Per cent HCl
16.2	1.1256	25.12	24.90	20.9	1.1684	33.68	33.12
16.3	1.1265	25.30	25.06	21.0	1.1694	33.88	33.31
16.4	1.1274	25.48	25.23	21.1	1.1703	34.06	33.50
16.5	1.1283	25.66	25.39	21.2	1.1713	34.26	33.69
16.6	1.1292	25.84	25.56	21.3	1.1722	34.44	33.88
16.7	1.1301	26.02	25.72	21.4	1.1732	34.64	34.07
16.8	1.1310	26.20	25.89	21.5	1.1741	34.82	34.26
16.9	1.1319	26.38	26.05	21.6	1.1751	35.02	34.45
17.0	1.1328	26.56	26.22	21.7	1.1760	35.20	34.64
17.1	1.1336	26.72	26.39	21.8	1.1770	35.40	34.83
17.2	1.1345	26.90	26.56	21.9	1.1779	35.58	35.02
17.3	1.1354	27.08	26.73	22.0	1.1789	35.78	35.21
17.4	1.1363	27.26	26.90	22.1	1.1798	35.96	35.40
17.5	1.1372	27.44	27.07	22.2	1.1808	36.16	35.59
17.6	1.1381	27.62	27.24	22.3	1.1817	36.34	35.78
17.7	1.1390	27.80	27.41	22.4	1.1827	36.54	35.97
17.8	1.1399	27.98	27.58	22.5	1.1836	36.72	36.16
17.9	1.1408	28.16	27.75	22.6	1.1846	36.92	36.35
18.0	1.1417	28.34	27.92	22.7	1.1856	37.12	36.54
18.1	1.1426	28.52	28.09	22.8	1.1866	37.32	36.73
18.2	1.1435	28.70	28.26	22.9	1.1875	37.50	36.93
18.3	1.1444	28.88	28.44	23.0	1.1885	37.70	37.14
18.4	1.1453	29.06	28.61	23.1	1.1895	37.90	37.36
18.5	1.1462	29.24	28.78	23.2	1.1904	38.08	37.58
18.6	1.1471	29.42	28.95	23.3	1.1914	38.28	37.80
18.7	1.1480	29.60	29.13	23.4	1.1924	38.48	38.03
18.8	1.1489	29.78	29.30	23.5	1.1934	38.68	38.26
18.9	1.1498	29.96	29.48	23.6	1.1944	38.88	38.49
19.0	1.1508	30.16	29.65	23.7	1.1953	39.06	38.72
19.1	1.1517	30.34	29.83	23.8	1.1963	39.26	38.95
19.2	1.1526	30.52	30.00	23.9	1.1973	39.46	39.18
19.3	1.1535	30.70	30.18	24.0	1.1983	39.66	39.41
19.4	1.1544	30.88	30.35	24.1	1.1993	39.86	39.64
19.5	1.1554	31.08	30.53	24.2	1.2003	40.06	39.86
19.6	1.1563	31.26	30.71	24.3	1.2013	40.26	40.09
19.7	1.1572	31.44	30.90	24.4	1.2023	40.46	40.32
19.8	1.1581	31.62	31.08	24.5	1.2033	40.66	40.55
19.9	1.1590	31.80	31.27	24.6	1.2043	40.86	40.78
20.0	1.1600	32.00	31.45	24.7	1.2053	41.06	41.01
20.1	1.1609	32.18	31.64	24.8	1.2063	41.26	41.24
20.2	1.1619	32.38	31.82	24.9	1.2073	41.46	41.48
20.3	1.1628	32.56	32.01	25.0	1.2083	41.66	41.72
20.4	1.1637	32.74	32.19	25.1	1.2093	41.86	41.99
20.5	1.1647	32.94	32.38	25.2	1.2103	42.06	42.30
20.6	1.1656	33.12	32.56	25.3	1.2114	42.28	42.64
20.7	1.1666	33.32	32.75	25.4	1.2124	42.48	43.01
20.8	1.1675	33.50	32.93	25.5	1.2134	42.68	43.40

HYDROCYANIC ACID

Specific Gravity of Aqueous Hydrocyanic Acid Solutions at $\frac{20°}{4°}$ C.*

Bé.	Sp. gr.	Per cent HCN	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
54.4	0.759	80	607.2	37.91	5.067
56.2	0.752	82	616.6	38.49	5.146
57.9	0.745	84	625.8	39.07	5.222
59.7	0.738	86	634.7	39.62	5.297
61.5	0.731	88	643.3	40.16	5.368
63.4	0.724	90	651.6	40.68	5.438
65.3	0.717	92	659.6	41.18	5.505
66.9	0.711	94	668.3	41.72	5.577
68.9	0.704	96	675.8	42.19	5.640
70.9	0.697	98	683.1	42.64	5.700
72.6	0.691	100	691.0	43.14	5.767

Specific Gravity of Aqueous Hydrocyanic Acid Solutions at $\frac{15°}{4°}$ C.

Bé.	Sp. gr.	Per cent HCN	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
10.3	0.998	1	9.98	0.6230	0.0833
10.6	0.996	2	19.92	1.244	0.1662
11.0	0.993	4	39.72	2.480	0.3315
11.4	0.989	6	59.34	3.704	0.4952
12.3	0.984	8	78.72	4.914	0.6569
13.2	0.978	10	97.80	6.105	0.8162
14.2	0.971	12	116.5	7.274	0.9724
15.2	0.964	14	135.0	8.425	1.126
16.4	0.956	16	153.0	9.549	1.276

HYDROFLUOSILICIC ACID

SPECIFIC GRAVITY OF AQUEOUS HYDROFLUOSILICIC ACID SOLUTIONS AT 17.5° C. (STOLBA)

Bé.	Sp. gr.	Per cent H_2SiF_6	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.6	1.0040	0.5	5.020	0.3134	0.0419
1.2	1.0080	1.0	10.08	0.6293	0.0841
1.7	1.0120	1.5	15.18	0.9476	0.1267
2.3	1.0161	2.0	20.32	1.269	0.1696
2.9	1.0201	2.5	25.50	1.592	0.2128
3.4	1.0242	3.0	30.73	1.918	0.2564
4.0	1.0283	3.5	35.99	2.247	0.3004
4.6	1.0324	4.0	41.30	2.578	0.3446
5.1	1.0366	4.5	46.65	2.912	0.3893
5.7	1.0407	5.0	52.04	3.248	0.4342
6.2	1.0449	5.5	57.47	3.588	0.4796
6.8	1.0491	6.0	62.95	3.930	0.5253
7.3	1.0533	6.5	68.46	4.274	0.5714
7.9	1.0576	7.0	74.03	4.622	0.6178
8.4	1.0618	7.5	79.64	4.971	0.6646
9.0	1.0661	8.0	85.29	5.324	0.7118
9.5	1.0704	8.5	90.98	5.680	0.7593
10.1	1.0747	9.0	96.72	6.038	0.8072
10.6	1.0791	9.5	102.5	6.400	0.8555
11.2	1.0834	10.0	108.3	6.763	0.9041
11.7	1.0878	10.5	114.2	7.130	0.9532
12.2	1.0922	11.0	120.1	7.500	1.003
12.8	1.0966	11.5	126.1	7.873	1.052
13.3	1.1011	12.0	132.1	8.249	1.103
13.8	1.1055	12.5	138.2	8.627	1.153
14.4	1.1100	13.0	144.3	9.008	1.204
14.9	1.1145	13.5	150.5	9.393	1.256
15.4	1.1190	14.0	156.7	9.780	1.307
16.0	1.1236	14.5	162.9	10.17	1.360
16.5	1.1281	15.0	169.2	10.56	1.412
17.0	1.1327	15.5	175.6	10.96	1.465
17.5	1.1373	16.0	182.0	11.36	1.519
18.0	1.1419	16.5	188.4	11.76	1.572
18.5	1.1466	17.0	194.9	12.17	1.627
19.0	1.1512	17.5	201.5	12.58	1.681
19.6	1.1559	18.0	208.1	12.99	1.736
20.1	1.1606	18.5	214.7	13.40	1.792
20.6	1.1653	19.0	221.4	13.82	1.848
21.1	1.1701	19.5	228.2	14.24	1.904
21.6	1.1748	20.0	235.0	14.67	1.961
22.1	1.1796	20.5	241.8	15.10	2.018
22.6	1.1844	21.0	248.7	15.53	2.076

HYDROFLUOSILICIC ACID (Continued)

SPECIFIC GRAVITY OF AQUEOUS HYDROFLUOSILICIC ACID SOLUTIONS AT 17.5° C. (STOLBA)

Bé.	Sp. gr.	Per cent H_2SiF_6	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
23.1	1.1892	21.5	255.7	15.96	2.134
23.6	1.1941	22.0	262.7	16.40	2.192
24.1	1.1989	22.5	269.8	16.84	2.251
24.6	1.2038	23.0	276.9	17.28	2.311
25.0	1.2087	23.5	284.0	17.73	2.370
25.5	1.2136	24.0	291.3	18.18	2.431
26.0	1.2186	24.5	298.6	18.64	2.492
26.5	1.2235	25.0	305.9	19.09	2.553
27.0	1.2285	25.5	313.3	19.56	2.614
27.5	1.2335	26.0	320.7	20.02	2.676
27.9	1.2385	26.5	328.2	20.49	2.739
28.4	1.2436	27.0	335.8	20.96	2.802
28.9	1.2486	27.5	343.4	21.44	2.865
29.3	1.2537	28.0	351.0	21.91	2.929
29.8	1.2588	28.5	358.8	22.40	2.994
30.3	1.2639	29.0	366.5	22.88	3.059
30.7	1.2691	29.5	374.4	23.37	3.124
31.2	1.2742	30.0	382.3	23.86	3.190
31.7	1.2794	30.5	390.2	24.36	3.256
32.1	1.2846	31.0	398.2	24.86	3.323
32.6	1.2898	31.5	406.3	25.36	3.391
33.0	1.2951	32.0	414.4	25.87	3.459
33.5	1.3003	32.5	422.6	26.38	3.527
34.0	1.3065	33.0	431.1	26.92	3.598
34.4	1.3109	33.5	439.2	27.41	3.665
34.8	1.3162	34.0	447.5	27.94	3.735

MAGNESIUM CHLORIDE

SPECIFIC GRAVITY OF AQUEOUS MAGNESIUM CHLORIDE SOLUTIONS AT $\frac{20°}{4°}$ C.*

Bé.	Sp. gr.	Per cent $MgCl_2$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
2.1	1.0146	2	20.29	1.267	0.1693
4.4	1.0311	4	41.24	2.575	0.3442
6.6	1.0478	6	62.87	3.925	0.5247
8.8	1.0646	8	85.17	5.317	0.7107
10.9	1.0816	10	108.2	6.752	0.9026
13.1	1.0989	12	131.9	8.232	1.100
15.1	1.1164	14	156.3	9.757	1.304
17.2	1.1342	16	181.5	11.33	1.514
19.2	1.1523	18	207.4	12.95	1.731
21.1	1.1706	20	234.1	14.62	1.954
26.0	1.2184	25	304.6	19.02	2.542
30.7	1.2688	30	380.6	23.76	3.177

Bé.	Sp. gr.	Per cent $MgCl_2 + 6H_2O$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
2.1	1.0146	4.270	43.32	2.705	0.3616
4.4	1.0311	8.540	88.06	5.497	0.7349
6.6	1.0478	12.81	134.2	8.380	1.120
8.8	1.0646	17.08	181.8	11.35	1.518
10.9	1.0816	21.35	230.9	14.42	1.927
13.1	1.0989	25.62	281.6	17.58	2.350
15.1	1.1164	29.89	333.7	20.83	2.785
17.2	1.1342	34.16	387.5	24.19	3.233
19.2	1.1523	38.43	442.8	27.65	3.696
21.1	1.1706	42.70	499.9	31.21	4.172
26.0	1.2184	53.38	650.4	40.60	5.427
30.7	1.2688	64.05	812.7	50.73	6.782

MAGNESIUM CHLORIDE

SPECIFIC GRAVITY OF AQUEOUS MAGNESIUM CHLORIDE SOLUTIONS AT 14° C. (OUDEMANS)

Bé.	Sp. gr.	Per cent $MgCl_2 + 6H_2O$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.5	1.0033	1	10.03	0.6263	0.0837
1.1	1.0073	2	20.15	1.258	0.1681
1.6	1.0113	3	30.34	1.894	0.2532
2.2	1.0154	4	40.62	2.536	0.3390
2.8	1.0194	5	50.97	3.182	0.4254
3.3	1.0234	6	61.40	3.833	0.5124
3.9	1.0274	7	71.92	4.490	0.6002
4.4	1.0314	8	82.51	5.151	0.6886
5.0	1.0355	9	93.20	5.818	0.7777
5.5	1.0395	10	104.0	6.489	0.8675
6.0	1.0435	11	114.8	7.166	0.9579
6.6	1.0476	12	125.7	7.848	1.049
7.1	1.0517	13	136.7	8.535	1.141
7.7	1.0558	14	147.8	9.227	1.234
8.2	1.0599	15	159.0	9.925	1.327
8.7	1.0641	16	170.3	10.63	1.421
9.3	1.0682	17	181.6	11.34	1.515
9.8	1.0724	18	193.0	12.05	1.611
10.3	1.0765	19	204.5	12.77	1.707
10.8	1.0807	20	216.1	13.49	1.804
11.4	1.0849	21	227.8	14.22	1.901
11.9	1.0891	22	239.6	14.96	2.000
12.4	1.0933	23	251.5	15.70	2.098
12.9	1.0976	24	263.4	16.44	2.198
13.4	1.1018	25	275.5	17.20	2.299
13.9	1.1061	26	287.6	17.95	2.400
14.4	1.1103	27	299.8	18.71	2.502
14.9	1.1146	28	312.1	19.48	2.604
15.4	1.1189	29	324.5	20.26	2.708
15.9	1.1232	30	337.0	21.04	2.812
16.4	1.1275	31	349.5	21.82	2.917
16.9	1.1319	32	362.2	22.61	3.023
17.4	1.1363	33	375.0	23.41	3.129
17.9	1.1407	34	387.8	24.21	3.237
18.4	1.1451	35	400.8	25.02	3.345
18.9	1.1495	36	413.8	25.83	3.453
19.4	1.1540	37	427.0	26.66	3.563
19.8	1.1584	38	440.2	27.48	3.673
20.3	1.1628	39	453.5	28.31	3.784
20.8	1.1673	40	466.9	29.15	3.897
21.3	1.1718	41	480.4	29.99	4.009
21.7	1.1763	42	494.0	30.84	4.123
22.2	1.1809	43	507.8	31.70	4.238
22.7	1.1855	44	521.6	32.56	4.353
23.2	1.1901	45	535.5	33.43	4.469
23.6	1.1948	46	549.6	34.31	4.587
24.1	1.1995	47	563.8	35.19	4.705
24.6	1.2042	48	578.0	36.08	4.824

MAGNESIUM CHLORIDE (Continued)

Specific Gravity of Aqueous Magnesium Chloride Solutions at 14° C. (Oudemans)

Bé.	Sp. gr.	Per cent $MgCl_2$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.5	1.0033	0.47	4.699	0.2934	0.0392
1.1	1.0073	0.94	9.436	0.5891	0.0787
1.6	1.0113	1.41	14.21	0.8871	0.1186
2.2	1.0154	1.87	19.02	1.188	0.1588
2.8	1.0194	2.34	23.87	1.490	0.1992
3.3	1.0234	2.81	28.76	1.795	0.2400
3.9	1.0274	3.28	33.68	2.103	0.2811
4.4	1.0314	3.75	38.65	2.413	0.3225
5.0	1.0355	4.22	43.65	2.725	0.3643
5.5	1.0395	4.68	48.69	3.039	0.4063
6.0	1.0435	5.15	53.76	3.356	0.4487
6.6	1.0476	5.62	58.88	3.676	0.4914
7.1	1.0517	6.09	64.04	3.998	0.5344
7.7	1.0558	6.56	69.23	4.322	0.5777
8.2	1.0599	7.03	74.46	4.649	0.6214
8.7	1.0641	7.49	79.74	4.978	0.6655
9.3	1.0682	7.96	85.05	5.310	0.7098
9.8	1.0724	8.43	90.41	5.644	0.7545
10.3	1.0765	8.90	95.80	5.980	0.7995
10.8	1.0807	9.37	101.2	6.320	0.8448
11.4	1.0849	9.84	106.7	6.661	0.8905
11.9	1.0891	10.3	112.2	7.006	0.9365
12.4	1.0933	10.8	117.8	7.352	0.9829
12.9	1.0976	11.2	123.4	7.702	1.030
13.4	1.1018	11.7	129.0	8.054	1.077
13.9	1.1061	12.2	134.7	8.409	1.124
14.4	1.1103	12.6	140.4	8.765	1.172
14.9	1.1146	13.1	146.2	9.125	1.220
15.4	1.1189	13.6	152.0	9.487	1.268
15.9	1.1232	14.1	157.8	9.862	1.317
16.4	1.1275	14.5	163.7	10.22	1.366
16.9	1.1319	15.0	169.6	10.59	1.416
17.4	1.1363	15.5	175.6	10.96	1.466
17.9	1.1407	15.9	181.7	11.34	1.516
18.4	1.1451	16.4	187.7	11.72	1.567
18.9	1.1495	16.9	193.8	12.10	1.617
19.4	1.1540	17.3	200.0	12.48	1.669
19.8	1.1584	17.8	206.2	12.87	1.721
20.3	1.1628	18.3	212.4	13.26	1.773
20.8	1.1673	18.7	218.7	13.65	1.825
21.3	1.1718	19.2	225.0	14.05	1.878
21.7	1.1763	19.7	231.4	14.45	1.931
22.2	1.1809	20.1	237.8	14.85	1.985
22.7	1.1855	20.6	244.3	15.25	2.039
23.2	1.1901	21.1	250.8	15.66	2.093
23.6	1.1948	21.5	257.4	16.07	2.148
24.1	1.1995	22.0	264.1	16.48	2.204
24.6	1.2042	22.5	270.7	16.90	2.259

MAGNESIUM SULFATE

SPECIFIC GRAVITY OF AQUEOUS MAGNESIUM SULFATE SOLUTIONS AT $\frac{20°}{4°}$ C.*

Bé.	Sp. gr.	Per cent $MgSO_4$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
2.6	1.0186	2	20.37	1.272	0.1700
5.5	1.0392	4	41.57	2.595	0.3469
8.2	1.0602	6	63.61	3.971	0.5309
10.9	1.0816	8	86.53	5.402	0.7221
13.6	1.1034	10	110.3	6.889	0.9208
16.2	1.1256	12	135.1	8.432	1.127
18.7	1.1484	14	160.8	10.04	1.342
21.3	1.1717	16	187.5	11.70	1.564
23.3	1.1955	18	215.2	13.43	1.796
26.1	1.2198	20	244.0	15.23	2.036
28.5	1.2447	22	273.8	17.09	2.285
30.8	1.2701	24	304.8	19.03	2.544
33.1	1.2961	26	337.0	21.04	2.812

Bé.	Sp. gr.	Per cent $MgSO_4 + 7H_2O$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
2.6	1.0186	4.095	41.71	2.604	0.3481
5.5	1.0392	8.190	85.11	5.314	0.7103
8.2	1.0602	12.29	130.3	8.131	1.087
10.9	1.0816	16.38	177.2	11.06	1.479
13.6	1.1034	20.48	225.9	14.10	1.886
16.2	1.1256	24.57	276.6	17.27	2.308
18.7	1.1484	28.67	329.2	20.55	2.747
21.3	1.1717	32.76	383.9	23.96	3.203
23.3	1.1955	36.86	440.6	27.51	3.677
26.1	1.2198	40.95	499.5	31.18	4.169
28.5	1.2447	45.05	560.7	35.00	4.679
30.8	1.2701	49.14	624.2	38.96	5.209
33.1	1.2961	53.24	690.0	43.08	5.758

NICKEL CHLORIDE

Specific Gravity of Aqueous Nickel Chloride Solutions at $\frac{20°}{4°}$ C.*

Bé.	Sp. gr.	Per cent $NiCl_2$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.2	1.008	1	10.08	0.6293	0.0841
2.6	1.018	2	20.36	1.271	0.1699
5.2	1.037	4	41.48	2.589	0.3462
7.8	1.057	6	63.42	3.959	0.5293
10.5	1.078	8	86.24	5.384	0.7197
13.1	1.099	10	109.9	6.861	0.9171
15.7	1.121	12	134.5	8.398	1.123
18.1	1.143	14	160.0	9.990	1.335
20.8	1.167	16	186.7	11.66	1.558
23.3	1.191	18	214.4	13.38	1.789
25.7	1.215	20	243.0	15.17	2.028
31.7	1.280	25	320.0	19.98	2.670
37.8	1.353	30	405.9	25.34	3.387

NICKEL NITRATE

SPECIFIC GRAVITY OF AQUEOUS NICKEL NITRATE SOLUTIONS AT $\frac{20°}{4°}$ C.*

Bé.	Sp. gr.	Per cent $Ni(NO_3)_2$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.0	1.007	1	10.07	0.6286	0.0840
2.1	1.015	2	20.30	1.267	0.1694
4.6	1.033	4	41.32	2.579	0.3448
6.9	1.050	6	63.00	3.933	0.5258
9.4	1.069	8	85.52	5.339	0.7137
11.7	1.088	10	108.8	6.792	0.9080
14.0	1.107	12	132.8	8.293	1.109
16.3	1.127	14	157.8	9.850	1.317
18.7	1.148	16	183.7	11.47	1.533
21.0	1.169	18	210.4	13.14	1.756
23.3	1.191	20	238.2	14.87	1.988
28.9	1.249	25	312.3	19.49	2.606
34.4	1.311	30	393.3	24.55	3.282
39.7	1.377	35	482.0	30.09	4.022

NICKEL SULFATE

SPECIFIC GRAVITY OF AQUEOUS NICKEL SULFATE SOLUTIONS AT $\frac{18°}{4°}$ C.*

Bé.	Sp. gr.	Per cent $NiSO_4$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.3	1.009	1	10.09	0.6299	0.0842
2.8	1.020	2	20.40	1.274	0.1702
5.8	1.042	4	41.68	2.602	0.3478
8.6	1.063	6	63.78	3.982	0.5323
11.4	1.085	8	86.80	5.419	0.7244
14.3	1.109	10	110.9	6.923	0.9255
17.0	1.133	12	136.0	8.488	1.135
19.8	1.158	14	162.1	10.12	1.353
22.4	1.183	16	189.3	11.82	1.580
25.1	1.209	18	217.6	13.59	1.816

NITRIC ACID

Specific Gravity of Aqueous Nitric Acid Solutions at $\frac{20°}{4°}$ C.*

Bé.	Sp. gr.	Per cent HNO_3	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.5	1.0036	1	10.04	0.6265	0.0838
1.3	1.0091	2	20.18	1.260	0.1684
2.1	1.0146	3	30.44	1.900	0.2540
2.9	1.0201	4	40.80	2.547	0.3405
3.6	1.0256	5	51.28	3.201	0.4279
4.4	1.0312	6	61.87	3.862	0.5163
5.2	1.0369	7	72.58	4.531	0.6057
5.9	1.0427	8	83.42	5.207	0.6961
6.7	1.0485	9	94.37	5.891	0.7875
7.5	1.0543	10	105.4	6.582	0.8798
8.2	1.0602	11	116.6	7.280	0.9732
9.0	1.0661	12	127.9	7.986	1.068
9.8	1.0721	13	139.4	8.701	1.163
10.5	1.0781	14	150.9	9.422	1.260
11.3	1.0842	15	162.6	10.15	1.357
12.0	1.0903	16	174.4	10.89	1.456
12.8	1.0964	17	186.4	11.64	1.555
13.5	1.1026	18	198.5	12.39	1.656
14.2	1.1088	19	210.7	13.15	1.758
15.0	1.1150	20	223.0	13.92	1.861
15.7	1.1213	21	235.5	14.70	1.965
16.4	1.1276	22	248.1	15.49	2.070
17.1	1.1340	23	260.8	16.28	2.177
17.9	1.1404	24	273.7	17.09	2.284
18.6	1.1469	25	286.7	17.90	2.393
19.4	1.1534	26	299.9	18.72	2.503
20.0	1.1600	27	313.2	19.55	2.614
20.7	1.1666	28	326.6	20.39	2.726
21.4	1.1733	29	340.3	21.24	2.840
22.1	1.1800	30	354.0	22.10	2.954
22.8	1.1867	31	367.9	22.97	3.070
23.5	1.1934	32	381.9	23.84	3.187
24.2	1.2002	33	396.1	24.73	3.305
24.9	1.2071	34	410.4	25.62	3.425
25.6	1.2140	35	424.9	26.53	3.546
26.2	1.2205	36	439.4	27.43	3.667
26.8	1.2270	37	454.0	28.34	3.789
27.5	1.2335	38	468.7	29.26	3.912
28.1	1.2399	39	483.6	30.19	4.035
28.7	1.2463	40	498.5	31.12	4.160
29.3	1.2527	41	513.6	32.06	4.286
29.8	1.2591	42	528.8	33.01	4.413
30.4	1.2655	43	544.2	33.97	4.541
31.0	1.2719	44	559.6	34.94	4.670
31.6	1.2783	45	575.2	35.91	4.800
32.1	1.2847	46	591.0	36.89	4.932
32.7	1.2911	47	606.8	37.88	5.064
33.2	1.2975	48	622.8	38.88	5.197
33.8	1.3040	49	639.0	39.89	5.332
34.3	1.3100	50	655.0	40.89	5.466
34.8	1.3160	51	671.2	41.90	5.601
35.3	1.3219	52	687.4	42.91	5.736
35.8	1.3278	53	703.7	43.93	5.873
36.3	1.3336	54	720.1	44.96	6.010

NITRIC ACID (Continued)

SPECIFIC GRAVITY OF AQUEOUS NITRIC ACID SOLUTIONS AT $\frac{20°}{4°}$ C.*

Bé.	Sp. gr.	Per cent HNO_3	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
36.7	1.3393	55	736.6	45.98	6.147
37.2	1.3449	56	753.1	47.02	6.285
37.6	1.3505	57	769.8	48.06	6.424
38.1	1.3560	58	786.5	49.10	6.563
38.5	1.3614	59	803.2	50.14	6.703
38.9	1.3667	60	820.0	51.19	6.843
39.3	1.3719	61	836.9	52.24	6.984
39.7	1.3769	62	853.7	53.29	7.124
40.1	1.3818	63	870.5	54.34	7.265
40.4	1.3866	64	887.4	55.40	7.406
40.8	1.3913	65	904.3	56.46	7.547
41.1	1.3959	66	921.3	57.51	7.688
41.5	1.4004	67	938.3	58.57	7.830
41.8	1.4048	68	955.3	59.63	7.972
42.1	1.4091	69	972.3	60.70	8.114
42.4	1.4134	70	989.4	61.76	8.257
42.7	1.4176	71	1006	62.83	8.399
43.0	1.4218	72	1024	63.91	8.543
43.3	1.4258	73	1041	64.98	8.686
43.6	1.4298	74	1058	66.05	8.830
43.9	1.4337	75	1075	67.13	8.973
44.1	1.4375	76	1093	68.20	9.117
44.4	1.4413	77	1110	69.28	9.262
44.7	1.4450	78	1127	70.36	9.406
44.9	1.4486	79	1144	71.44	9.550
45.1	1.4521	80	1162	72.52	9.694
45.4	1.4555	81	1179	73.60	9.839
45.6	1.4589	82	1196	74.68	9.983
45.8	1.4622	83	1214	75.76	10.13
46.1	1.4655	84	1231	76.85	10.27
46.3	1.4686	85	1248	77.93	10.42
46.5	1.4716	86	1266	79.01	10.56
46.7	1.4745	87	1283	80.08	10.71
46.8	1.4773	88	1300	81.16	10.85
47.0	1.4800	89	1317	82.23	10.99
47.2	1.4826	90	1334	83.30	11.14
47.4	1.4850	91	1351	84.36	11.28
47.5	1.4873	92	1368	85.42	11.42
47.6	1.4892	93	1385	86.46	11.56
47.8	1.4912	94	1402	87.51	11.70
47.9	1.4932	95	1419	88.56	11.84
48.0	1.4952	96	1435	89.61	11.98
48.2	1.4974	97	1452	90.67	12.12
48.4	1.5008	98	1471	91.82	12.27
48.7	1.5056	99	1491	93.05	12.44
49.2	1.5129	100	1513	94.45	12.63

NITRIC ACID

Authority — W. C. Ferguson

This table has been approved and adopted as a Standard by the Manufacturing Chemists' Association of the United States.

Specific Gravity determinations were made at 60° F., compared with water at 60° F.

From the Specific Gravities, the corresponding degrees Baumé were calculated by the following formula:

$$\text{Baumé} = 145 - \frac{145}{\text{Sp. Gr.}}.$$

Baumé Hydrometers for use with this table must be graduated by the above formula, which formula should *always* be printed on the scale.

Atomic weights from F. W. Clarke's table of 1901. O = 16.

Allowance for Temperature

At 10°–20°	Bé. — 1/30° Bé. or .00029 Sp. Gr.	= 1° F.
20°–30°	Bé. — 1/23° Bé. or .00044 " "	= 1° F.
30°–40°	Bé. — 1/20° Bé. or .00060 " "	= 1° F.
40°–48.5°	Bé. — 1/17° Bé. or .00084 " "	= 1° F.

Bé.°	Sp. gr.	Tw.°	Per cent HNO_3.	Bé.°	Sp. gr.	Tw.°	Per cent HNO_3.
10.00	1.0741	14.82	12.86	15.25	1.1176	23.52	19.70
10.25	1.0761	15.22	13.18	15.50	1.1197	23.94	20.02
10.50	1.0781	15.62	13.49	15.75	1.1219	24.38	20.36
10.75	1.0801	16.02	13.81	16.00	1.1240	24.80	20.69
11.00	1.0821	16.42	14.13	16.25	1.1262	25.24	21.03
11.25	1.0841	16.82	14.44	16.50	1.1284	25.68	21.36
11.50	1.0861	17.22	14.76	16.75	1.1306	26.12	21.70
11.75	1.0881	17.62	15.07	17.00	1.1328	26.56	22.04
12.00	1.0902	18.04	15.41	17.25	1.1350	27.00	22.38
12.25	1.0922	18.44	15.72	17.50	1.1373	27.46	22.74
12.50	1.0943	18.86	16.05	17.75	1.1395	27.90	23.08
12.75	1.0964	19.28	16.39	18.00	1.1417	28.34	23.42
13.00	1.0985	19.70	16.72	18.25	1.1440	28.80	23.77
13.25	1.1006	20.12	17.05	18.50	1.1462	29.24	24.11
13.50	1.1027	20.54	17.38	18.75	1.1485	29.70	24.47
13.75	1.1048	20.96	17.71	19.00	1.1508	30.16	24.82
14.00	1.1069	21.38	18.04	19.25	1.1531	30.62	25.18
14.25	1.1090	21.80	18.37	19.50	1.1554	31.08	25.53
14.50	1.1111	22.22	18.70	19.75	1.1577	31.54	25.88
14.75	1.1132	22.64	19.02	20.00	1.1600	32.00	26.24
15.00	1.1154	23.08	19.36	20.25	1.1624	32.48	26.61

NITRIC ACID (Continued)

Bé.°	Sp. gr.	Tw.°	Per cent HNO_3.	Bé.°	Sp. gr.	Tw.°	Per cent HNO_3.
20.50	1.1647	32.94	26.96	31.50	1.2775	55.50	43.89
20.75	1.1671	33.42	27.33	31.75	1.2804	56.08	44.34
21.00	1.1694	33.88	27.67	32.00	1.2832	56.64	44.78
21.25	1.1718	34.36	28.02	32.25	1.2861	57.22	45.24
21.50	1.1741	34.82	28.36	32.50	1.2889	57.78	45.68
21.75	1.1765	35.30	28.72	32.75	1.2918	58.36	46.14
22.00	1.1789	35.78	29.07	33.00	1.2946	58.92	46.58
22.25	1.1813	36.26	29.43	33.25	1.2975	59.50	47.04
22.50	1.1837	36.74	29.78	33.50	1.3004	60.08	47.49
22.75	1.1861	37.22	30.14	33.75	1.3034	60.68	47.95
23.00	1.1885	37.70	30.49	34.00	1.3063	61.26	48.42
23.25	1.1910	38.20	30.86	34.25	1.3093	61.86	48.90
23.50	1.1934	38.68	31.21	34.50	1.3122	62.44	49.35
23.75	1.1959	39.18	31.58	34.75	1.3152	63.04	49.83
24.00	1.1983	39.66	31.94	35.00	1.3182	63.64	50.32
24.25	1.2008	40.16	32.31	35.25	1.3212	64.24	50.81
24.50	1.2033	40.66	32.68	35.50	1.3242	64.84	51.30
24.75	1.2058	41.16	33.05	35.75	1.3273	65.46	51.80
25.00	1.2083	41.66	33.42	36.00	1.3303	66.06	52.30
25.25	1.2109	42.18	33.80	36.25	1.3334	66.68	52.81
25.50	1.2134	42.68	34.17	36.50	1.3364	67.28	53.32
25.75	1.2160	43.20	34.56	36.75	1.3395	67.90	53.84
26.00	1.2185	43.70	34.94	37.00	1.3426	68.52	54.36
26.25	1.2211	44.22	35.33	37.25	1.3457	69.14	54.89
26.50	1.2236	44.72	35.70	37.50	1.3488	69.76	55.43
26.75	1.2262	45.24	36.09	37.75	1.3520	70.40	55.97
27.00	1.2288	45.76	36.48	38.00	1.3551	71.02	56.52
27.25	1.2314	46.28	36.87	38.25	1.3583	71.66	57.08
27.50	1.2340	46.80	37.26	38.50	1.3615	72.30	57.65
27.75	1.2367	47.34	37.67	38.75	1.3647	72.94	58.23
28.00	1.2393	47.86	38.06	39.00	1.3679	73.58	58.82
28.25	1.2420	48.40	38.46	39.25	1.3712	74.24	59.43
28.50	1.2446	48.92	38.85	39.50	1.3744	74.88	60.06
28.75	1.2473	49.46	39.25	39.75	1.3777	75.54	60.71
29.00	1.2500	50.00	39.66	40.00	1.3810	76.20	61.38
29.25	1.2527	50.54	40.06	40.25	1.3843	76.86	62.07
29.50	1.2554	51.08	40.47	40.50	1.3876	77.52	62.77
29.75	1.2582	51.64	40.89	40.75	1.3909	78.18	63.48
30.00	1.2609	52.18	41.30	41.00	1.3942	78.84	64.20
30.25	1.2637	52.74	41.72	41.25	1.3976	79.52	64.93
30.50	1.2664	53.28	42.14	41.50	1.4010	80.20	65.67
30.75	1.2692	53.84	42.58	41.75	1.4044	80.88	66.42
31.00	1.2719	54.38	43.00	42.00	1.4078	81.96	67.18
31.25	1.2747	54.94	43.44	42.25	1.4112	82.24	67.95

NITRIC ACID (Continued)

Bé.°	Sp. gr.	Tw.°	Per cent HNO_3	Bé.°	Sp. gr.	Tw.°	Per cent HNO_3
42.50	1.4146	82.92	68.73	45.50	1.4573	91.46	79.03
42.75	1.4181	83.62	69.52	45.75	1.4610	92.20	80.04
43.00	1.4216	84.32	70.33	46.00	1.4646	92.92	81.08
43.25	1.4251	85.02	71.15	46.25	1.4684	93.68	82.18
43.50	1.4286	85.72	71.98	46.50	1.4721	94.42	83.33
43.75	1.4321	86.42	72.82	46.75	1.4758	95.16	84.48
44.00	1.4356	87.12	73.67	47.00	1.4796	95.92	85.70
44.25	1.4392	87.84	74.53	47.25	1.4834	96.68	86.98
44.50	1.4428	88.56	75.40	47.50	1.4872	97.44	88.32
44.75	1.4464	89.28	76.28	47.75	1.4910	98.20	89.76
45.00	1.4500	90.00	77.17	48.00	1.4948	98.96	91.35
45.25	1.4536	90.72	78.07	48.25	1.4987	99.74	93.13
				48.50	1.5026	100.52	95.11

OXALIC ACID

SPECIFIC GRAVITY OF AQUEOUS OXALIC ACID SOLUTIONS AT 17.5° C. (GERLACH)

Bé.	Sp. gr.	Per cent $H_2C_2O_4 + 2H_2O$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.5	1.0035	1	10.04	0.6265	0.0837
1.0	1.0070	2	20.14	1.257	0.1681
1.5	1.0105	3	30.32	1.892	0.2530
2.0	1.0140	4	40.56	2.532	0.3385
2.5	1.0175	5	50.88	3.176	0.4246
3.0	1.0210	6	61.26	3.824	0.5112
3.5	1.0245	7	71.72	4.477	0.5985
4.0	1.0280	8	82.24	5.134	0.6863
4.4	1.0315	9	92.84	5.795	0.7747
4.9	1.0350	10	103.5	6.461	0.8637
5.4	1.0385	11	114.2	7.131	0.9533
5.8	1.0420	12	125.0	7.806	1.043
6.3	1.0455	13	135.9	8.485	1.134

Bé.	Sp. gr.	Per cent $H_2C_2O_4$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.5	1.0035	0.71	7.166	0.4474	0.0598
1.0	1.0070	1.43	14.38	0.8979	0.1200
1.5	1.0105	2.14	21.65	1.351	0.1807
2.0	1.0140	2.86	28.97	1.808	0.2417
2.5	1.0175	3.57	36.33	2.268	0.3032
3.0	1.0210	4.28	43.75	2.731	0.3651
3.5	1.0245	5.00	51.21	3.197	0.4274
4.0	1.0280	5.71	58.73	3.666	0.4901
4.4	1.0315	6.43	66.30	4.139	0.5533
4.9	1.0350	7.14	73.91	4.614	0.6168
5.4	1.0385	7.86	81.58	5.093	0.6808
5.8	1.0420	8.57	89.30	5.574	0.7452
6.3	1.0455	9.28	97.06	6.059	0.8100

PHOSPHORIC ACID

Specific Gravity of Aqueous Phosphoric Acid Solutions at $\frac{20°}{4°}$ C.*

Bé.	Sp. gr.	Per cent H_3PO_4	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.6	1.0038	1.	10.04	0.6266	0.0838
1.3	1.0092	2	20.18	1.260	0.1684
2.8	1.0200	4	40.80	2.547	0.3405
4.3	1.0309	6	61.85	3.861	0.5162
5.8	1.0420	8	83.36	5.204	0.6957
7.3	1.0532	10	105.3	6.575	0.8789
8.8	1.0647	12	127.8	7.976	1.066
10.3	1.0764	14	150.7	9.408	1.258
11.8	1.0884	16	174.1	10.87	1.453
13.3	1.1008	18	198.1	12.37	1.654
14.8	1.1134	20	222.7	13.90	1.858
16.3	1.1263	22	247.8	15.47	2.068
17.8	1.1395	24	273.5	17.07	2.282
19.2	1.1529	26	299.8	18.71	2.501
20.7	1.1665	28	326.6	20.39	2.726
22.2	1.1805	30	354.2	22.11	2.955
25.8	1.216	35	425.6	26.57	3.552
29.4	1.254	40	501.6	31.31	4.186
32.9	1.293	45	581.9	36.32	4.856
36.4	1.335	50	667.5	41.67	5.570
39.9	1.379	55	758.5	47.35	6.329
43.3	1.426	60	855.6	53.41	7.140
46.7	1.475	65	958.8	59.85	8.001
50.0	1.526	70	1068	66.68	8.914
53.2	1.579	75	1184	73.93	9.883
56.2	1.633	80	1306	81.55	10.90
59.2	1.689	85	1436	89.62	11.98
62.0	1.746	90	1571	98.10	13.11
63.1	1.770	92	1628	101.7	13.59
64.2	1.794	94	1686	105.3	14.07
65.3	1.819	96	1746	109.0	14.57
66.4	1.844	98	1807	112.8	15.08
67.5	1.870	100	1870	116.7	15.61

PHOSPHORIC ACID

Specific Gravity of Aqueous Phosphoric Acid Solutions at $\frac{20°}{4°}$ C.*

Bé.	Sp. gr.	Per cent P_2O_5	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.6	1.0038	0.72	7.271	0.4539	0.0607
1.3	1.0092	1.4	14.62	0.9128	0.1220
2.8	1.0200	2.9	29.56	1.845	0.2466
4.3	1.0309	4.3	44.81	2.797	0.3739
5.8	1.0420	5.8	60.39	3.770	0.5039
7.3	1.0532	7.2	76.29	4.763	0.6367
8.8	1.0647	8.7	92.55	5.778	0.7724
10.3	1.0764	10.1	109.2	6.815	0.9110
11.8	1.0884	11.6	126.1	7.875	1.053
13.3	1.1008	13.0	143.5	8.960	1.198
14.8	1.1134	14.5	161.3	10.07	1.346
16.3	1.1263	15.9	179.5	11.21	1.498
17.8	1.1395	17.4	198.1	12.37	1.653
19.2	1.1529	18.8	217.1	13.56	1.812
20.7	1.1665	20.3	236.6	14.77	1.975
22.2	1.1805	21.7	256.5	16.02	2.141
25.8	1.216	25.4	308.3	19.25	2.573
29.4	1.254	29.0	363.4	22.68	3.032
32.9	1.293	32.6	421.5	26.31	3.517
36.4	1.335	36.2	483.5	30.19	4.035
39.9	1.379	39.8	549.4	34.30	4.585
43.3	1.426	43.5	619.8	38.69	5.172
46.7	1.475	47.1	694.5	43.36	5.796
50.0	1.526	50.7	773.8	48.31	6.458
53.2	1.579	54.3	857.9	53.55	7.159
56.2	1.633	58.0	946.4	59.08	7.898
59.2	1.689	61.6	1040	64.92	8.679
62.0	1.746	65.2	1138	71.06	9.500
63.1	1.770	66.6	1180	73.64	9.844
64.2	1.794	68.1	1222	76.26	10.19
65.3	1.819	69.5	1265	78.97	10.56
66.4	1.844	71.0	1309	81.72	10.92
67.5	1.870	72.4	1355	84.57	11.30

POTASSIUM BROMIDE

SPECIFIC GRAVITY OF AQUEOUS POTASSIUM BROMIDE SOLUTIONS AT $\frac{20°}{4°}$ C.*

Bé.	Sp. gr.	Per cent KBr	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.8	1.0054	1	10.05	0.6276	0.0839
1.8	1.0127	2	20.25	1.264	0.1690
3.9	1.0275	4	41.10	2.566	0.3430
5.9	1.0426	6	62.56	3.905	0.5220
8.0	1.0581	8	84.65	5.284	0.7064
10.0	1.0740	10	107.4	6.705	0.8963
12.0	1.0903	12	130.8	8.168	1.092
14.0	1.1070	14	155.0	9.675	1.293
16.0	1.1242	16	179.9	11.23	1.501
18.0	1.1419	18	205.5	12.83	1.715
20.0	1.1601	20	232.0	14.48	1.936
22.0	1.1788	22	259.3	16.19	2.164
24.0	1.1980	24	287.5	17.95	2.399
25.9	1.2178	26	316.6	19.77	2.642
27.9	1.2383	28	346.7	21.64	2.893
29.9	1.2593	30	377.8	23.58	3.153
34.7	1.3147	35	460.1	28.73	3.840
39.5	1.3746	40	549.8	34.32	4.589

POTASSIUM CARBONATE

SPECIFIC GRAVITY OF AQUEOUS POTASSIUM CARBONATE SOLUTIONS AT $\frac{20°}{4°}$ C.*

Bé.	Sp. gr.	Per cent K_2CO_3	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.0	1.0072	1	10.07	0.6288	0.0841
2.3	1.0163	2	20.33	1.269	0.1696
4.8	1.0345	4	41.38	2.583	0.3453
7.3	1.0529	6	63.17	3.944	0.5272
9.7	1.0715	8	85.72	5.351	0.7154
12.0	1.0904	10	109.0	6.807	0.9100
14.3	1.1096	12	133.2	8.312	1.111
16.6	1.1291	14	158.1	9.868	1.319
18.8	1.1490	16	183.8	11.48	1.534
21.0	1.1692	18	210.5	13.14	1.756

POTASSIUM CARBONATE (Continued)

SPECIFIC GRAVITY OF AQUEOUS POTASSIUM CARBONATE SOLUTIONS AT $\frac{20°}{4°}$ C.*

Bé.	Sp. gr.	Per cent K_2CO_3	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
23.1	1.1898	20	238.0	14.86	1.986
25.2	1.2107	22	266.4	16.63	2.223
27.3	1.2320	24	295.7	18.46	2.468
29.3	1.2536	26	325.9	20.35	2.720
31.3	1.2756	28	357.2	22.30	2.981
33.3	1.2979	30	389.4	24.31	3.249
38.0	1.3548	35	474.2	29.60	3.957
42.5	1.4141	40	565.6	35.31	4.720
46.8	1.4759	45	664.2	41.46	5.543
50.9	1.5404	50	770.2	48.08	6.427

POTASSIUM CHLORIDE

SPECIFIC GRAVITY OF AQUEOUS POTASSIUM CHLORIDE SOLUTIONS AT $\frac{20°}{4°}$ C.*

Bé.	Sp. gr.	Per cent KCl	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.7	1.0046	1	10.05	0.6271	0.0838
1.6	1.0110	2	20.22	1.262	0.1687
3.4	1.0239	4	40.96	2.557	0.3418
5.2	1.0369	6	62.21	3.884	0.5192
6.9	1.0500	8	84.00	5.244	0.7010
8.6	1.0633	10	106.3	6.638	0.8874
10.3	1.0768	12	129.2	8.067	1.078
12.0	1.0905	14	152.7	9.531	1.274
13.7	1.1043	16	176.7	11.03	1.475
15.4	1.1185	18	201.3	12.57	1.680
17.0	1.1328	20	226.6	14.14	1.891
18.6	1.1474	22	252.4	15.76	2.107
20.2	1.1623	24	279.0	17.41	2.328

POTASSIUM CHROME ALUM

Specific Gravity of Aqueous Potassium Chrome Alum Solutions at $\frac{15°}{4°}$ C.*

Bé.	Sp. gr.	Per cent $K_2Cr_2(SO_4)_4$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.0	1.007	1	10.07	0.6286	0.0840
2.3	1.016	2	20.32	1.269	0.1696
4.8	1.034	4	41.36	2.582	0.3452
7.2	1.052	6	63.12	3.940	0.5267
9.5	1.070	8	85.60	5.344	0.7143
11.9	1.089	10	108.9	6.798	0.9088
14.3	1.109	12	133.1	8.308	1.111
16.6	1.129	14	158.1	9.867	1.319
18.9	1.150	16	184.0	11.49	1.536
21.2	1.171	18	210.8	13.16	1.759
23.5	1.193	20	238.6	14.90	1.991
25.8	1.216	22	267.5	16.70	2.233
28.0	1.239	24	297.4	18.56	2.482
30.2	1.263	26	328.4	20.50	2.740
32.5	1.289	28	360.9	22.53	3.012
34.7	1.315	30	394.5	24.63	3.292
40.2	1.383	35	484.1	30.22	4.040
45.4	1.456	40	582.4	36.36	4.860
50.4	1.533	45	689.9	43.07	5.757
55.2	1.615	50	807.5	50.41	6.739

Bé.	Sp. gr.	Per cent $K_2Cr_2(SO_4)_4 + 24H_2O$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.0	1.007	1.763	17.76	1.108	0.1481
2.3	1.016	3.527	35.83	2.237	0.2991
4.8	1.034	7.053	72.93	4.553	0.6087
7.2	1.052	10.58	111.30	6.948	0.9287
9.5	1.070	14.11	150.9	9.423	1.260
11.9	1.089	17.63	192.0	11.99	1.603
14.3	1.109	21.16	234.7	14.65	1.958
16.6	1.129	24.69	278.7	17.40	2.326
18.9	1.150	28.21	324.4	20.25	2.708
21.2	1.171	31.74	371.7	23.20	3.102
23.5	1.193	35.27	420.7	26.26	3.511
25.8	1.216	38.79	471.7	29.45	3.937
28.0	1.239	42.32	524.3	32.73	4.376
30.2	1.263	45.85	579.0	36.15	4.832
32.5	1.289	49.37	636.4	39.73	5.311
34.7	1.315	52.90	695.3	43.43	5.805
40.2	1.383	61.72	853.5	53.28	7.123
45.4	1.456	70.53	1026.9	64.11	8.570
50.4	1.533	79.35	1216.4	75.94	10.15
55.2	1.615	88.17	1423.9	88.89	11.88

POTASSIUM CHROMATE

SPECIFIC GRAVITY OF AQUEOUS POTASSIUM CHROMATE SOLUTIONS AT $\frac{18°}{4°}$ C.*

Bé.	Sp. gr.	Per cent K_2CrO_4	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.0	1.0066	1	10.07	0.6284	0.0840
2.1	1.0147	2	20.29	1.267	0.1694
4.4	1.0311	4	41.24	2.575	0.3442
6.6	1.0477	6	62.86	3.924	0.5246
8.8	1.0647	8	85.18	5.317	0.7108
11.0	1.0821	10	108.2	6.755	0.9030
13.2	1.0999	12	132.0	8.240	1.101
15.3	1.1181	14	156.5	9.772	1.306
17.4	1.1366	16	181.9	11.35	1.518
19.5	1.1555	18	208.0	12.98	1.736
21.6	1.1748	20	235.0	14.67	1.961
23.6	1.1945	22	262.8	16.41	2.193
25.6	1.2147	24	291.5	18.20	2.433
27.6	1.2354	26	321.2	20.05	2.681
29.6	1.2566	28	351.8	21.96	2.936
31.6	1.2784	30	383.5	23.94	3.201

SPECIFIC GRAVITY OF POTASSIUM CHROMATE SOLUTIONS AT 19.5° C. (SCHIFF)

Bé.	Sp. gr.	Per cent K_2CrO_4	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.2	1.0080	1	10.08	0.6293	0.0841
2.3	1.0161	2	20.32	1.269	0.1696
3.4	1.0243	3	30.73	1.918	0.2564
4.6	1.0325	4	41.30	2.578	0.3447
5.7	1.0408	5	52.04	3.249	0.4343
6.8	1.0492	6	62.95	3.930	0.5254
7.9	1.0576	7	74.03	4.622	0.6178
9.0	1.0663	8	85.30	5.325	0.7119
10.1	1.0750	9	96.75	6.040	0.8074
11.2	1.0837	10	108.4	6.765	0.9044
12.3	1.0925	11	120.2	7.502	1.003
13.4	1.1014	12	132.2	8.251	1.103
14.4	1.1104	13	144.4	9.011	1.205
15.5	1.1195	14	156.7	9.784	1.308

POTASSIUM CHROMATE (Continued)

SPECIFIC GRAVITY OF POTASSIUM CHROMATE SOLUTIONS AT 19.5° C. (SCHIFF)

Bé.	Sp. gr.	Per cent K_2CrO_4	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
16.5	1.1287	15	169.3	10.57	1.413
17.6	1.1380	16	182.1	11.37	1.519
18.6	1.1474	17	195.1	12.18	1.628
19.7	1.1570	18	208.3	13.00	1.738
20.7	1.1667	19	221.7	13.84	1.850
21.8	1.1765	20	235.3	14.69	1.964
22.8	1.1864	21	249.1	15.55	2.079
23.8	1.1964	22	263.2	16.43	2.197
24.8	1.2066	23	277.5	17.32	2.316
25.8	1.2169	24	292.1	18.23	2.437
26.9	1.2274	25	306.9	19.16	2.561
27.9	1.2379	26	321.9	20.09	2.686
28.9	1.2485	27	337.1	21.04	2.813
29.8	1.2592	28	352.6	22.01	2.942
30.8	1.2700	29	368.3	22.99	3.074
31.8	1.2808	30	384.2	23.99	3.207
32.8	1.2921	31	400.6	25.01	3.343
33.8	1.3035	32	417.1	26.04	3.481
34.7	1.3151	33	434.0	27.09	3.622
35.7	1.3268	34	451.1	28.16	3.765
36.7	1.3386	35	468.5	29.25	3.910
37.6	1.3505	36	486.2	30.35	4.057
38.6	1.3625	37	504.1	31.47	4.207
39.5	1.3746	38	522.3	32.61	4.359
40.4	1.3868	39	540.9	33.76	4.514
41.4	1.3991	40	559.6	34.94	4.670

POTASSIUM DICHROMATE

SPECIFIC GRAVITY OF AQUEOUS POTASSIUM DICHROMATE SOLUTIONS AT $\frac{20°}{4°}$ C.*

Bé.	Sp. gr.	Per cent $K_2Cr_2O_7$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.8	1.0052	1	10.05	0.6275	0.0839
1.7	1.0122	2	20.24	1.264	0.1689
3.7	1.0264	4	41.06	2.563	0.3426
5.7	1.0408	6	62.45	3.898	0.5211
7.6	1.0554	8	84.43	5.271	0.7046
9.5	1.0703	10	107.0	6.682	0.8932

POTASSIUM HYDROXIDE

Specific Gravity of Aqueous Potassium Hydroxide Solutions at $\frac{15°}{4°}$ C.*

Bé.	Sp. gr.	Per cent KOH	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.2	1.0083	1	10.08	0.6295	0.0841
2.5	1.0175	2	20.35	1.270	0.1698
3.8	1.0267	3	30.80	1.923	0.2570
5.0	1.0359	4	41.44	2.587	0.3458
6.3	1.0452	5	52.26	3.262	0.4361
7.5	1.0544	6	63.26	3.949	0.5280
8.7	1.0637	7	74.46	4.648	0.6214
9.9	1.0730	8	85.84	5.359	0.7164
11.0	1.0824	9	97.42	6.081	0.8130
12.2	1.0918	10	109.2	6.816	0.9111
13.3	1.1013	11	121.1	7.563	1.011
14.5	1.1108	12	133.3	8.321	1.112
15.6	1.1203	13	145.6	9.092	1.215
16.7	1.1299	14	158.2	9.875	1.320
17.8	1.1396	15	170.9	10.67	1.427
18.8	1.1493	16	183.9	11.48	1.535
19.9	1.1590	17	197.0	12.30	1.644
20.9	1.1688	18	210.4	13.13	1.756
22.0	1.1786	19	223.9	13.98	1.869
23.0	1.1884	20	237.7	14.84	1.983
24.0	1.1984	21	251.7	15.71	2.100
25.0	1.2083	22	265.8	16.59	2.218
26.0	1.2184	23	280.2	17.49	2.339
27.0	1.2285	24	294.8	18.41	2.461
27.9	1.2387	25	309.7	19.33	2.584
28.9	1.2489	26	324.7	20.27	2.710
29.8	1.2592	27	340.0	21.22	2.837
30.8	1.2695	28	355.5	22.19	2.966
31.7	1.2800	29	371.2	23.17	3.098
32.6	1.2905	30	387.2	24.17	3.231
33.6	1.3010	31	403.3	25.18	3.366
34.5	1.3117	32	419.7	26.20	3.503
35.4	1.3224	33	436.4	27.24	3.642
36.2	1.3331	34	453.3	28.30	3.783
37.1	1.3440	35	470.4	29.37	3.926
38.0	1.3549	36	487.8	30.45	4.070
38.8	1.3659	37	505.4	31.55	4.218
39.7	1.3769	38	523.2	32.66	4.366
40.5	1.3879	39	541.3	33.79	4.517
41.4	1.3991	40	559.6	34.94	4.670
42.2	1.4103	41	578.2	36.10	4.825
43.0	1.4215	42	597.0	37.27	4.982
43.8	1.4329	43	616.1	38.46	5.142
44.6	1.4443	44	635.5	39.67	5.303
45.4	1.4558	45	655.1	40.90	5.467
46.2	1.4673	46	675.0	42.14	5.633
47.0	1.4790	47	695.1	43.39	5.801
47.7	1.4907	48	715.5	44.67	5.971
48.5	1.5025	49	736.2	45.96	6.144
49.2	1.5143	50	757.2	47.27	6.319
50.0	1.5262	51	778.4	48.59	6.496
50.7	1.5382	52	799.9	49.93	6.675

POTASSIUM IODIDE

Specific Gravity of Aqueous Potassium Iodide Solutions at $\frac{20°}{4°}$ C.*

Bé.	Sp. gr.	Per cent KI	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.8	1.0055	1	10.06	0.6277	0.0839
1.9	1.0130	2	20.26	1.265	0.1691
4.0	1.0281	4	41.12	2.567	0.3432
6.1	1.0437	6	62.62	3.909	0.5226
8.2	1.0597	8	84.78	5.292	0.7075
10.3	1.0761	10	107.6	6.718	0.8980
12.3	1.0930	12	131.2	8.188	1.095
14.4	1.1104	14	155.5	9.705	1.297
16.5	1.1284	16	180.5	11.27	1.507
18.6	1.1469	18	206.4	12.89	1.723
20.6	1.1660	20	233.2	14.56	1.946
23.7	1.1857	22	260.9	16.28	2.177
24.8	1.2060	24	289.4	18.07	2.415
26.8	1.2270	26	319.0	19.92	2.662
28.9	1.2487	28	349.6	21.83	2.918
30.9	1.2712	30	381.4	23.81	3.183
36.0	1.3308	35	465.8	29.08	3.887
41.1	1.3959	40	558.4	34.86	4.660
46.2	1.4672	45	660.2	41.22	5.510
51.2	1.5458	50	772.9	48.25	6.450
56.2	1.6327	55	898.0	56.06	7.494

POTASSIUM NITRATE

SPECIFIC GRAVITY OF AQUEOUS POTASSIUM NITRATE SOLUTIONS AT $\frac{20°}{4°}$ C.*

Bé.	Sp. gr.	Per cent KNO_3	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.6	1.0045	1	10.05	0.6271	0.0838
1.5	1.0108	2	20.22	1.262	0.1687
3.3	1.0234	4	40.94	2.556	0.3416
5.1	1.0363	6	62.18	3.882	0.5189
6.8	1.0494	8	83.95	5.241	0.7006
8.6	1.0627	10	106.3	6.634	0.8868
10.3	1.0762	12	129.1	8.062	1.078
12.0	1.0899	14	152.6	9.525	1.273
13.7	1.1039	16	176.6	11.03	1.474
15.3	1.1181	18	201.3	12.56	1.680
17.0	1.1326	20	226.5	14.14	1.890
18.6	1.1473	22	252.4	15.76	2.106
20.2	1.1623	24	279.0	17.41	2.328

POTASSIUM SULFATE

SPECIFIC GRAVITY OF AQUEOUS POTASSIUM SULFATE SOLUTIONS AT $\frac{20°}{4°}$ C.*

Bé.	Sp. gr.	Per cent K_2SO_4	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.9	1.0063	1	10.06	0.6282	0.0840
2.1	1.0145	2	20.29	1.267	0.1693
4.4	1.0310	4	41.24	2.574	0.3442
6.6	1.0477	6	62.86	3.924	0.5246
8.8	1.0646	8	85.17	5.317	0.7107
11.0	1.0817	10	108.17	6.753	0.9027

POTASSIUM TARTRATE

Specific Gravity of Aqueous Potassium Tartrate Solutions at $\frac{20°}{4°}$ C.*

Bé.	Sp. gr.	Per cent $K_2C_4H_4O_6$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.7	1.0048	1	10.05	0.6273	0.0839
1.6	1.0114	2	20.23	1.263	0.1688
3.5	1.0248	4	40.99	2.559	0.3421
5.4	1.0383	6	62.30	3.889	0.5199
7.2	1.0519	8	84.15	5.253	0.7023
8.9	1.0657	10	106.6	6.653	0.8894
10.7	1.0798	12	129.6	8.089	1.081
12.5	1.0941	14	153.2	9.562	1.278
14.2	1.1087	16	177.4	11.07	1.480
16.0	1.1236	18	202.3	12.63	1.688
17.7	1.1387	20	227.7	14.22	1.901
19.4	1.1540	22	253.9	15.85	2.119
21.0	1.1696	24	280.7	17.52	2.343
22.7	1.1855	26	308.2	19.24	2.572
24.3	1.2017	28	336.5	21.01	2.808
26.0	1.2181	30	365.4	22.81	3.050
30.0	1.2606	35	441.2	27.54	3.682
33.9	1.3051	40	522.0	32.59	4.357
37.7	1.3516	45	608.2	37.97	5.076
41.4	1.4001	50	700.1	43.70	5.842

Bé.	Sp. gr.	Per cent $K_2C_4H_4O_6 + \frac{1}{2}H_2O$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.7	1.0048	1.040	10.45	0.6522	0.0872
1.6	1.0114	2.080	21.03	1.313	0.1755
3.5	1.0248	4.159	42.62	2.661	0.3557
5.4	1.0383	6.239	64.78	4.044	0.5406
7.2	1.0519	8.319	87.50	5.462	0.7302
8.9	1.0657	10.40	110.8	6.918	0.9247
10.7	1.0798	12.48	134.7	8.411	1.124
12.5	1.0941	14.56	159.3	9.943	1.329
14.2	1.1087	16.64	184.5	11.52	1.539
16.0	1.1236	18.72	210.3	13.13	1.755
17.7	1.1387	20.80	236.8	14.78	1.976
19.4	1.1540	22.88	264.0	16.48	2.203
21.0	1.1696	24.96	291.9	18.22	2.436
22.7	1.1855	27.03	320.5	20.01	2.675
24.3	1.2017	29.12	349.9	21.84	2.920
26.0	1.2181	31.19	380.0	23.72	3.171
30.0	1.2606	36.39	458.8	28.64	3.829
33.9	1.3051	41.59	542.8	33.89	4.530
37.7	1.3516	46.79	632.4	39.48	5.278
41.4	1.4001	51.99	727.9	45.44	6.075

SODIUM ARSENATE

SPECIFIC GRAVITY OF AQUEOUS DI-SODIUM ARSENATE SOLUTIONS AT $\frac{14°}{4°}$ C.*

Bé.	Sp. gr.	Per cent Na_2HAsO_4	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.2	1.0083	1	10.08	0.6295	0.0841
2.5	1.0175	2	20.35	1.270	0.1698
5.1	1.0365	4	41.46	2.588	0.3460
7.7	1.0563	6	63.38	3.957	0.5289
10.3	1.0768	8	86.14	5.378	0.7189
12.9	1.0980	10	109.8	6.854	0.9163
15.5	1.1197	12	134.4	8.388	1.121
18.0	1.1419	14	159.9	9.980	1.334
20.5	1.1645	16	186.3	11.63	1.555

Bé.	Sp. gr.	Per cent Na_2HAsO_4	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.2	1.0083	2.163	21.80	1.361	0.1819
2.5	1.0175	4.325	44.01	2.747	0.3672
5.1	1.0365	8.650	89.66	5.597	0.7482
7.7	1.0563	12.98	137.1	8.556	1.144
10.3	1.0768	17.30	186.3	11.63	1.555
12.9	1.0980	21.63	237.4	14.82	1.982
15.5	1.1197	25.95	290.6	18.14	2.425
18.0	1.1419	30.28	345.7	21.58	2.885
20.5	1.1645	34.60	402.9	25.15	3.363

SODIUM ARSENATE

SPECIFIC GRAVITY OF AQUEOUS DI-SODIUM ARSENATE SOLUTIONS AT 14° C. (SCHIFF)

Bé.	Sp. gr.	Per cent $Na_2HAsO_4 + 12H_2O$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.6	1.0042	1	10.04	0.6269	0.0838
1.2	1.0084	2	20.17	1.259	0.1683
1.8	1.0126	3	30.38	1.896	0.2535
2.4	1.0168	4	40.67	2.539	0.3394
3.0	1.0212	5	51.06	3.188	0.4261
3.6	1.0256	6	61.54	3.842	0.5135
4.2	1.0300	7	72.10	4.501	0.6017
4.8	1.0344	8	82.75	5.166	0.6906
5.4	1.0389	9	93.50	5.837	0.7803
6.0	1.0434	10	104.3	6.514	0.8707
6.6	1.0479	11	115.3	7.196	0.9619
7.2	1.0525	12	126.3	7.885	1.054
7.8	1.0571	13	137.4	8.579	1.147
8.4	1.0618	14	148.7	9.280	1.241
9.0	1.0665	15	160.0	9.987	1.335
9.6	1.0712	16	171.4	10.70	1.430
10.2	1.0759	17	182.9	11.42	1.526
10.8	1.0807	18	194.5	12.14	1.623
11.4	1.0855	19	206.2	12.88	1.721
12.0	1.0904	20	218.1	13.61	1.820
12.6	1.0953	21	230.0	14.36	1.920
13.2	1.1002	22	242.0	15.11	2.020
13.8	1.1052	23	254.2	15.87	2.121
14.4	1.1102	24	266.4	16.63	2.224
15.0	1.1153	25	278.8	17.41	2.327
15.6	1.1204	26	291.3	18.19	2.431
16.2	1.1255	27	303.9	18.97	2.536
16.8	1.1306	28	316.6	19.76	2.642
17.3	1.1358	29	329.4	20.56	2.749
17.9	1.1410	30	342.3	21.37	2.857
18.5	1.1463	31	355.4	22.18	2.965
19.1	1.1516	32	368.5	23.01	3.075
19.7	1.1569	33	381.8	23.83	3.186
20.2	1.1623	34	395.2	24.67	3.298
20.8	1.1677	35	408.7	25.51	3.411
21.4	1.1731	36	422.3	26.36	3.524
22.0	1.1786	37	436.1	27.22	3.639
22.5	1.1838	38	449.1	28.03	3.748
23.1	1.1896	39	464.0	28.96	3.872
23.7	1.1952	40	478.1	29.85	3.990

SODIUM ARSENATE

Specific Gravity of Aqueous Tri-sodium Arsenate Solutions at $\frac{17°}{4°}$ C.*

Bé.	Sp. gr.	Per cent Na_3AsO_4	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.4	1.0097	1	10.10	0.6303	0.0843
2.9	1.0207	2	20.41	1.274	0.1704
6.0	1.0431	4	41.72	2.605	0.3482
9.0	1.0659	6	63.95	3.992	0.5337
11.9	1.0892	8	87.14	5.440	0.7272
14.7	1.1130	10	111.3	6.948	0.9288
17.5	1.1373	12	136.5	8.520	1.1389

Bé.	Sp. gr.	Per cent $Na_3AsO_4 + 12H_2O$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.4	1.0097	2.040	20.59	1.286	0.1719
2.9	1.0207	4.079	41.64	2.599	0.3475
6.0	1.0431	8.158	85.10	5.313	0.7102
9.0	1.0659	12.237	130.4	8.143	1.089
11.9	1.0892	16.317	177.7	11.09	1.483
14.7	1.1130	20.396	227.0	14.17	1.894
17.5	1.1373	24.4752	278.4	17.38	2.323

Specific Gravity of Aqueous Tri-sodium Arsenate Solutions at 17° C. (Schiff)

Bé.	Sp. gr.	Per cent $Na_3AsO_4 + 12H_2O$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.8	1.0053	1	10.05	0.6276	0.0839
1.5	1.0107	2	20.21	1.262	0.1687
2.3	1.0161	3	30.48	1.903	0.2544
3.1	1.0215	4	40.86	2.551	0.3410
3.8	1.0270	5	51.35	3.206	0.4285
4.6	1.0325	6	61.95	3.867	0.5170
5.3	1.0380	7	72.66	4.536	0.6064

SODIUM ARSENATE (Continued)

SPECIFIC GRAVITY OF AQUEOUS TRI-SODIUM ARSENATE SOLUTIONS AT 17° C. (SCHIFF)

Bé.	Sp. gr.	Per cent $Na_3AsO_4 + 12H_2O$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
6.0	1.0435	8	83.48	5.211	0.6967
6.8	1.0491	9	94.42	5.894	0.7880
7.5	1.0547	10	105.5	6.584	0.8802
8.3	1.0603	11	116.6	7.281	0.9733
9.0	1.0659	12	127.9	7.985	1.067
9.7	1.0716	13	139.3	8.697	1.163
10.4	1.0773	14	150.8	9.415	1.259
11.1	1.0830	15	162.5	10.14	1.356
11.8	1.0887	16	174.2	10.87	1.454
12.5	1.0945	17	186.1	11.62	1.553
13.2	1.1003	18	198.1	12.36	1.653
13.9	1.1061	19	210.2	13.12	1.754
14.6	1.1120	20	222.4	13.88	1.856
15.3	1.1179	21	234.8	14.66	1.959
16.0	1.1238	22	247.2	15.43	2.063

SODIUM BROMIDE

SPECIFIC GRAVITY OF AQUEOUS SODIUM BROMIDE SOLUTIONS AT $\frac{20°}{4°}$ C.*

Bé.	Sp. gr.	Per cent NaBr	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.9	1.0060	1	10.06	0.6280	0.0840
2.0	1.0139	2	20.28	1.266	0.1692
4.2	1.0298	4	41.19	2.571	0.3438
6.4	1.0462	6	62.77	3.919	0.5238
8.6	1.0631	8	85.05	5.309	0.7097
10.8	1.0803	10	108.0	6.744	0.9015
13.0	1.0981	12	131.8	8.226	1.100
15.1	1.1164	14	156.3	9.757	1.304
17.3	1.1352	16	181.6	11.34	1.516
19.4	1.1546	18	207.8	12.97	1.734
21.5	1.1745	20	234.9	14.66	1.960
23.7	1.1951	22	262.9	16.41	2.194
25.8	1.2163	24	291.9	18.22	2.436
27.9	1.2382	26	321.9	20.10	2.687
30.0	1.2608	28	353.0	22.04	2.946
32.1	1.2841	30	385.2	24.05	3.215
37.3	1.3462	35	471.2	29.41	3.932
42.4	1.4138	40	565.5	35.30	4.719

SODIUM CARBONATE

Specific Gravity of Aqueous Sodium Carbonate Solutions at $\frac{20°}{4°}$ C.*

Bé.	Sp. gr.	Per cent Na_2CO_3	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.2	1.0086	1	10.09	0.6296	0.0842
2.7	1.0190	2	20.38	1.272	0.1701
5.6	1.0398	4	41.59	2.596	0.3471
8.3	1.0606	6	63.64	3.973	0.5311
10.9	1.0816	8	86.53	5.402	0.7221
13.5	1.1029	10	110.3	6.885	0.9204
16.0	1.1244	12	134.9	8.423	1.126
18.5	1.1463	14	160.5	10.02	1.339

Bé.	Sp. gr.	Per cent $Na_2CO_3 + 10H_2O$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.2	1.0086	2.70	27.23	1.700	0.2272
2.7	1.0190	5.40	55.02	3.435	0.4592
5.6	1.0398	10.80	112.3	7.010	0.9370
8.3	1.0606	16.20	171.8	10.72	1.434
10.9	1.0816	21.60	233.6	14.58	1.949
13.5	1.1029	27.00	297.7	18.59	2.485
16.0	1.1244	32.40	364.3	22.74	3.040
18.5	1.1463	37.80	433.3	27.05	3.616

SODIUM CHLORIDE

SPECIFIC GRAVITY OF AQUEOUS SODIUM CHLORIDE SOLUTIONS AT $\frac{20°}{4°}$ C.*

Bé.	Sp. gr.	Per cent NaCl	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.8	1.0053	1	10.05	0.6276	0.0839
1.8	1.0125	2	20.25	1.264	0.1690
3.8	1.0268	4	41.07	2.564	0.3428
5.8	1.0413	6	62.48	3.900	0.5214
7.7	1.0559	8	84.47	5.273	0.7049
9.6	1.0707	10	107.1	6.684	0.8935
11.5	1.0857	12	130.3	8.133	1.087
13.3	1.1009	14	154.1	9.622	1.286
15.1	1.1162	16	178.6	11.15	1.490
16.9	1.1319	18	203.7	12.72	1.700
18.7	1.1478	20	229.6	14.33	1.916
20.4	1.1640	22	256.1	15.99	2.137
22.2	1.1804	24	283.3	17.69	2.364
23.9	1.1972	26	311.3	19.43	2.598

SODIUM CHROMATE

SPECIFIC GRAVITY OF AQUEOUS SODIUM CHROMATE SOLUTIONS AT $\frac{18°}{4°}$ C.*

Bé.	Sp. gr.	Per cent Na_2CrO_4	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.1	1.0074	1	10.07	0.6289	0.0841
2.3	1.0163	2	20.33	1.269	0.1696
4.8	1.0344	4	41.38	2.583	0.3453
7.3	1.0529	6	63.17	3.944	0.5272
9.7	1.0718	8	85.74	5.353	0.7156
12.1	1.0912	10	109.1	6.812	0.9106
14.5	1.1110	12	133.3	8.323	1.113
16.8	1.1312	14	158.4	9.886	1.322
19.1	1.1518	16	184.3	11.50	1.538
21.4	1.1728	18	211.1	13.18	1.762
23.6	1.1942	20	238.8	14.91	1.993
25.8	1.2160	22	267.5	16.70	2.233
27.9	1.2383	24	297.2	18.55	2.480
30.0	1.2611	26	327.9	20.47	2.736

SODIUM DICHROMATE

SPECIFIC GRAVITY OF AQUEOUS SODIUM DICHROMATE SOLUTIONS AT $\frac{15°}{4°}$ C.*

Bé.	Sp. gr.	Per cent $Na_2Cr_2O_7$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.9	1.006	1	10.06	0.6280	0.0840
1.9	1.013	2	20.26	1.265	0.1691
3.8	1.027	4	41.08	2.565	0.3428
5.7	1.041	6	62.46	3.899	0.5212
7.7	1.056	8	84.48	5.274	0.7050
9.5	1.070	10	107.0	6.680	0.8929
11.2	1.084	12	130.1	8.121	1.086
12.9	1.098	14	153.7	9.596	1.283
14.6	1.112	16	177.9	11.11	1.485
16.2	1.126	18	202.7	12.65	1.691
17.8	1.140	20	228.0	14.23	1.903
19.2	1.153	22	253.7	15.84	2.117
20.6	1.166	24	279.8	17.47	2.335
22.0	1.179	26	306.5	19.14	2.558
23.5	1.193	28	334.0	20.85	2.788
24.9	1.207	30	362.1	22.60	3.022
28.4	1.244	35	435.4	27.18	3.634
31.6	1.279	40	511.6	31.94	4.269
34.5	1.312	45	590.4	36.86	4.927
37.0	1.342	50	671.0	41.89	5.600

SODIUM HYDROXIDE

Specific Gravity of Aqueous Sodium Hydroxide Solutions at $\frac{20°}{4°}$ C.*

Bé.	Sp. gr.	Per cent NaOH	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.4	1.0095	1	10.10	0.6302	0.0842
2.9	1.0207	2	20.41	1.274	0.1704
4.5	1.0318	3	30.95	1.932	0.2583
6.0	1.0428	4	41.71	2.604	0.3481
7.4	1.0538	5	52.69	3.289	0.4397
8.8	1.0648	6	63.89	3.988	0.5332
10.2	1.0758	7	75.31	4.701	0.6284
11.6	1.0869	8	86.95	5.428	0.7256
12.9	1.0979	9	98.81	6.168	0.8246
14.2	1.1089	10	110.9	6.923	0.9254
16.8	1.1309	12	135.7	8.472	1.133
19.2	1.1530	14	161.4	10.08	1.347
21.6	1.1751	16	188.0	11.74	1.569
23.9	1.1972	18	215.5	13.45	1.798
26.1	1.2191	20	243.8	15.22	2.035
28.2	1.2411	22	273.0	17.05	2.279
30.2	1.2629	24	303.1	18.92	2.529
32.1	1.2848	26	334.0	20.85	2.788
34.0	1.3064	28	365.8	22.84	3.053
35.8	1.3279	30	398.4	24.87	3.324
37.5	1.3490	32	431.7	26.95	3.602
39.1	1.3696	34	465.7	29.07	3.886
40.7	1.3900	36	500.4	31.24	4.176
42.2	1.4101	38	535.8	33.45	4.472
43.6	1.4300	40	572.0	35.71	4.773
45.0	1.4494	42	608.7	38.00	5.080
46.3	1.4685	44	646.1	40.34	5.392
47.5	1.4873	46	684.2	42.71	5.709
48.8	1.5065	48	723.1	45.14	6.035
49.9	1.5253	50	762.7	47.61	6.364

SODIUM NITRATE

SPECIFIC GRAVITY OF AQUEOUS SODIUM NITRATE SOLUTIONS AT $\frac{20°}{4°}$ C.*

Bé.	Sp. gr.	Per cent $NaNO_3$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.7	1.0049	1	10.05	0.6273	0.0839
1.7	1.0117	2	20.23	1.263	0.1689
3.6	1.0254	4	41.02	2.561	0.3423
5.5	1.0392	6	62.35	3.892	0.5203
7.3	1.0532	8	84.26	5.260	0.7031
9.2	1.0674	10	106.7	6.663	0.8908
11.0	1.0819	12	129.8	8.105	1.083
12.8	1.0967	14	153.5	9.585	1.281
14.6	1.1118	16	177.9	11.11	1.485
16.4	1.1272	18	202.9	12.67	1.693
18.1	1.1429	20	228.6	14.27	1.908
19.9	1.1589	22	255.0	15.92	2.128
21.6	1.1752	24	282.0	17.61	2.354
23.3	1.1917	26	309.8	19.34	2.586
25.0	1.2085	28	338.4	21.12	2.824
26.7	1.2256	30	367.7	22.95	3.068
30.8	1.2701	35	444.5	27.75	3.710
34.9	1.3175	40	527.0	32.90	4.398
39.0	1.3683	45	615.7	38.44	5.138

SODIUM NITRITE

SPECIFIC GRAVITY OF AQUEOUS SODIUM NITRITE SOLUTIONS AT $\frac{15°}{4°}$ C.*

Bé.	Sp. gr.	Per cent $NaNO_2$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.8	1.0058	1	10.06	0.6279	0.0839
1.8	1.0125	2	20.25	1.264	0.1690
3.7	1.0260	4	41.04	2.562	0.3425
5.5	1.0397	6	62.38	3.894	0.5206
7.4	1.0535	8	84.28	5.261	0.7033
9.2	1.0675	10	106.8	6.664	0.8909
10.9	1.0816	12	129.8	8.103	1.083
12.7	1.0959	14	153.4	9.578	1.280
14.4	1.1103	16	177.6	11.09	1.483
16.1	1.1248	18	202.5	12.64	1.690
17.7	1.1394	20	227.9	14.23	1.902

SODIUM POTASSIUM TARTRATE

Specific Gravity of Aqueous Sodium Potassium Tartrate (Rochelle Salt) Solutions at $\frac{20°}{4°}$ C.*

Bé.	Sp. gr.	Per cent $NaKC_4H_4O_6$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.7	1.0049	1	10.05	0.6273	0.0839
1.7	1.0116	2	20.23	1.263	0.1688
3.6	1.0252	4	41.01	2.560	0.3422
5.4	1.0390	6	62.34	3.892	0.5202
7.3	1.0530	8	84.24	5.259	0.7030
9.1	1.0673	10	106.7	6.663	0.8907
11.0	1.0818	12	129.8	8.104	1.083
12.8	1.0965	14	153.5	9.583	1.281
14.5	1.1114	16	177.8	11.10	1.484
16.3	1.1265	18	202.8	12.66	1.692
18.0	1.1419	20	228.4	14.26	1.906
19.7	1.1576	22	254.7	15.90	2.125
21.4	1.1735	24	281.6	17.58	2.350
23.1	1.1896	26	309.3	19.31	2.581
24.8	1.2059	28	337.7	21.08	2.818
26.4	1.2225	30	366.8	22.90	3.061
28.0	1.2394	32	396.6	24.76	3.310
29.6	1.2566	34	427.2	26.67	3.565
31.2	1.2742	36	458.7	28.64	3.828

Bé.	Sp. gr.	Per cent $NaKC_4H_4O_6 + 4H_2O$	G. per liter	Lbs. per cu. ft.	Lb. per gal.
0.7	1.0049	1.343	13.50	0.8425	0.1127
1.7	1.0116	2.686	27.17	1.696	0.2267
3.6	1.0252	5.372	55.07	3.438	0.4596
5.4	1.0390	8.058	83.72	5.227	0.6986
7.3	1.0530	10.74	113.1	7.063	0.9441
9.1	1.0673	13.43	143.3	8.948	1.196
11.0	1.0818	16.12	174.3	10.88	1.455
12.8	1.0965	18.80	206.2	12.87	1.721
14.5	1.1114	21.49	238.8	14.91	1.993
16.3	1.1265	24.17	272.3	17.00	2.273
18.0	1.1419	26.86	306.7	19.15	2.560
19.7	1.1576	29.55	342.0	21.35	2.854
21.4	1.1735	32.23	378.2	23.61	3.157
23.1	1.1896	34.92	415.4	25.93	3.466
24.8	1.2059	37.60	453.5	28.31	3.784
26.4	1.2225	40.29	492.5	30.75	4.110
28.0	1.2394	42.98	532.6	33.25	4.445
29.6	1.2566	45.66	573.8	35.82	4.788
31.2	1.2742	48.35	616.1	38.46	5.141

SODIUM SILICATE

Specific Gravity of Aqueous Sodium Silicate Solutions at $\frac{20°}{4°}$ C.*

Bé.	Sp. gr.	Per cent $Na_2O + 3.9SiO_2$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.9	1.006	1	10.06	0.6280	0.0840
2.0	1.014	2	20.28	1.266	0.1692
4.2	1.030	4	41.20	2.572	0.3438
6.4	1.046	6	62.76	3.918	0.5327
8.6	1.063	8	85.04	5.309	0.7097
10.7	1.080	10	108.0	6.742	0.9013
12.9	1.098	12	131.8	8.225	1.100
14.6	1.116	14	156.2	9.754	1.304
17.1	1.134	16	181.4	11.33	1.514
19.2	1.153	18	207.5	12.96	1.732
21.3	1.172	20	234.4	14.63	1.956
23.3	1.191	22	262.0	16.36	2.187
25.3	1.211	24	290.6	18.14	2.425
27.3	1.232	26	320.3	20.00	2.673
29.3	1.253	28	350.8	21.90	2.928
31.3	1.275	30	382.5	23.88	3.192
33.3	1.298	32	415.4	25.93	3.466

Bé.	Sp. gr.	Per cent $Na_2O + 3.36SiO_2$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.9	1.006	1	10.06	0.6280	0.0840
2.0	1.014	2	20.28	1.266	0.1692
4.2	1.030	4	41.20	2.572	0.3438
6.5	1.047	6	62.82	3.922	0.5243
8.9	1.065	8	85.20	5.319	0.7110
11.1	1.083	10	108.3	6.761	0.9038
13.3	1.101	12	132.1	8.248	1.103
15.5	1.120	14	156.8	9.789	1.309
17.7	1.139	16	182.2	11.38	1.521
19.9	1.159	18	208.6	13.02	1.741
22.0	1.179	20	235.8	14.72	1.968
24.2	1.200	22	264.0	16.48	2.203
26.3	1.222	24	293.3	18.31	2.447
28.4	1.244	26	323.4	20.19	2.699
30.6	1.267	28	354.8	22.15	2.961
32.6	1.290	30	387.0	24.16	3.230
34.7	1.314	32	420.5	26.25	3.509
36.7	1.339	34	455.3	28.42	3.799
38.8	1.365	36	491.4	30.68	4.101
40.9	1.393	38	529.3	33.05	4.417

SODIUM SILICATE

Specific Gravity of Aqueous Sodium Silicate Solutions at $\frac{20°}{4°}$ C.*

Bé.	Sp. gr.	Per cent $Na_2O + 2.40SiO_2$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.0	1.007	1	10.07	0.6286	0.0840
2.3	1.016	2	20.32	1.269	0.1696
4.8	1.034	4	41.36	2.582	0.3452
7.2	1.052	6	63.12	3.940	0.5268
9.6	1.071	8	85.68	5.349	0.7150
12.0	1.090	10	109.0	6.805	0.9096
14.4	1.110	12	133.2	8.315	1.112
16.7	1.130	14	158.2	9.876	1.320
19.0	1.151	16	184.2	11.50	1.537

Bé.	Sp. gr.	Per cent $Na_2O + 2.44SiO_2$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
32.2	1.285	28	359.8	22.46	3.003
34.2	1.309	30	392.7	24.52	3.277
36.3	1.334	32	426.9	26.65	3.562
38.4	1.360	34	462.4	28.87	3.859
40.5	1.387	36	499.3	31.17	4.167
42.5	1.415	38	537.7	33.57	4.487
44.7	1.445	40	578.0	36.08	4.824

Bé.	Sp. gr.	Per cent $Na_2O + 2.06SiO_2$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.0	1.007	1	10.07	0.6286	0.0840
2.3	1.016	2	20.32	1.269	0.1696
4.9	1.035	4	41.40	2.584	0.3455
7.4	1.054	6	63.24	3.948	0.5278
9.9	1.073	8	85.84	5.359	0.7164
12.3	1.093	10	109.3	6.823	0.9121
14.7	1.113	12	133.6	8.338	1.115
17.1	1.134	14	158.8	9.911	1.325
19.6	1.156	16	185.0	11.55	1.544
21.9	1.178	18	212.0	13.24	1.770
24.2	1.200	20	240.0	14.98	2.003

SODIUM SILICATE (Continued)

Specific Gravity of Aqueous Sodium Silicate Solutions

$T \frac{20°}{4°}$ C.*

Bé.	Sp. gr.	Per cent $Na_2O + 2.06SiO_2$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
26.4	1.223	22	269.1	16.80	2.245
28.7	1.247	24	299.3	18.68	2.498
30.9	1.271	26	330.5	20.63	2.758
33.1	1.296	28	362.9	22.65	3.028
35.2	1.321	30	396.3	24.74	3.307
37.3	1.346	32	430.7	26.89	3.594
39.2	1.371	34	466.1	29.10	3.890
41.2	1.397	36	502.9	31.40	4.197
43.1	1.423	38	540.7	33.76	4.513
45.0	1.450	40	580.0	36.21	4.840
49.6	1.520	45	684.0	42.70	5.708
54.0	1.594	50	797.0	49.75	6.651
58.3	1.673	55	920.2	57.44	7.679

Bé.	Sp. gr.	Per cent $Na_2O + 1.69SiO_2$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.0	1.007	1	10.07	0.6286	0.0840
2.4	1.017	2	20.34	1.270	0.1697
5.0	1.036	4	41.44	2.587	0.3458
7.7	1.056	6	63.36	3.955	0.5288
10.4	1.077	8	86.16	5.379	0.7190
12.9	1.098	10	109.8	6.854	0.9163
15.4	1.119	12	134.3	8.383	1.121
17.9	1.141	14	159.7	9.972	1.333
20.3	1.163	16	186.1	11.62	1.553
22.7	1.186	18	213.5	13.33	1.782
25.2	1.210	20	242.0	15.11	2.020
27.5	1.234	22	271.5	16.95	2.266
29.8	1.259	24	302.2	18.86	2.522
32.1	1.284	26	333.8	20.84	2.786
34.3	1.310	28	366.8	22.90	3.061
36.6	1.337	30	401.1	25.04	3.347
38.8	1.365	32	436.8	27.27	3.645
41.0	1.394	34	474.0	29.59	3.955
43.2	1.424	36	512.6	32.00	4.278
45.4	1.456	38	553.3	34.54	4.617

SODIUM SULFATE

Specific Gravity of Aqueous Sodium Sulfate Solutions

AT $\frac{20°}{4°}$ C.*

Bé.	Sp. gr.	Per cent Na_2SO_4	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.1	1.0073	1	10.07	0.6288	0.0841
2.3	1.0164	2	20.33	1.269	0.1696
4.9	1.0348	4	41.39	2.584	0.3454
7.4	1.0535	6	63.21	3.946	0.5275
9.8	1.0724	8	85.79	5.356	0.7160
12.2	1.0915	10	109.2	6.814	0.9109
14.5	1.1109	12	133.3	8.322	1.112
16.8	1.1306	14	158.3	9.881	1.321
19.0	1.1506	16	184.1	11.49	1.536
21.2	1.1709	18	210.8	13.16	1.759
23.3	1.1915	20	238.3	14.88	1.989
25.4	1.2124	22	266.7	16.65	2.226
27.5	1.2336	24	296.1	18.48	2.471

Bé.	Sp. gr.	Per cent $Na_2SO_4 + 10H_2O$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.1	1.0073	2.268	22.85	1.426	0.1907
2.3	1.0164	4.536	46.11	2.878	0.3848
4.9	1.0348	9.073	93.88	5.861	0.7835
7.4	1.0535	13.61	143.4	8.950	1.197
9.8	1.0724	18.15	194.6	12.15	1.624
12.2	1.0915	22.68	247.6	5.46	2.066
14.5	1.1109	27.22	302.4	18.88	2.523
16.8	1.1306	31.75	359.0	22.41	2.996
19.0	1.1506	36.29	417.6	26.07	3.485
21.2	1.1709	40.83	478.1	29.84	3.989
23.3	1.1915	45.36	540.5	33.74	4.511
25.4	1.2124	49.90	605.0	37.77	4.049
27.5	1.2336	54.44	671.5	41.92	5.604

SODIUM SULFATE

SPECIFIC GRAVITY OF AQUEOUS SODIUM SULFATE SOLUTIONS AT 15° C. (GERLACH)

Bé.	Sp. gr.	Per cent $Na_2SO_4 + 10H_2O$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.6	1.004	1	10.04	0.6268	0.0838
1.2	1.008	2	20.16	1.259	0.1682
1.9	1.013	3	30.39	1.897	0.2536
2.3	1.016	4	40.64	2.537	0.3392
2.8	1.020	5	51.00	3.184	0.4256
3.4	1.024	6	61.44	3.836	0.5127
4.0	1.028	7	71.96	4.492	0.6005
4.5	1.032	8	82.56	5.154	0.6890
5.0	1.036	9	93.24	5.821	0.7781
5.6	1.040	10	104.0	6.492	0.8679
6.1	1.044	11	114.8	7.169	0.9584
6.5	1.047	12	125.6	7.843	1.048
7.2	1.052	13	136.8	8.538	1.141
7.7	1.056	14	147.8	9.229	1.234
8.2	1.060	15	159.0	9.926	1.327
8.7	1.064	16	170.2	10.63	1.421
9.4	1.069	17	181.7	11.34	1.517
9.9	1.073	18	193.1	12.06	1.612
10.4	1.077	19	204.6	12.77	1.708
11.0	1.082	20	216.4	13.51	1.806
11.5	1.086	21	228.1	14.24	1.903
12.0	1.090	22	239.8	14.97	2.001
12.5	1.094	23	251.6	15.71	2.100
12.9	1.098	24	263.5	16.45	2.199
13.5	1.103	25	275.8	17.21	2.301
14.0	1.107	26	287.8	17.97	2.402
14.5	1.111	27	300.0	18.73	2.503
15.1	1.116	28	312.5	19.51	2.608
15.5	1.120	29	324.8	20.28	2.711
16.1	1.125	30	337.5	21.07	2.817

SODIUM SULFATE

SPECIFIC GRAVITY OF AQUEOUS SODIUM SULFATE SOLUTIONS AT 15° C. (GERLACH)

Bé.	Sp. gr.	Per cent Na_2SO_4	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.6	1.004	0.44	4.440	0.2772	0.0371
1.2	1.008	0.88	8.916	0.5566	0.0744
1.9	1.013	1.33	13.44	0.8390	0.1122
2.3	1.016	1.77	17.97	1.122	0.1500
2.8	1.020	2.21	22.55	1.408	0.1882
3.4	1.024	2.65	27.17	1.696	0.2268
4.0	1.028	3.10	31.82	1.987	0.2656
4.5	1.032	3.54	36.51	2.279	0.3047
5.0	1.036	3.98	41.24	2.574	0.3441
5.6	1.040	4.42	45.99	2.871	0.3838
6.1	1.044	4.86	50.79	3.171	0.4238
6.5	1.047	5.31	55.56	3.469	0.4637
7.2	1.052	5.75	60.48	3.776	0.5047
7.7	1.056	6.19	65.38	4.082	0.5456
8.2	1.060	6.63	70.32	4.390	0.5868
8.7	1.064	7.08	75.29	4.700	0.6283
9.4	1.069	7.52	80.37	5.017	0.6707
9.9	1.073	7.96	85.42	5.332	0.7128
10.4	1.077	8.40	90.50	5.650	0.7552
11.0	1.082	8.85	95.70	5.974	0.7987
11.5	1.086	9.29	100.9	6.296	0.8417
12.0	1.090	9.73	106.1	6.620	0.8850
12.5	1.094	10.2	111.3	6.947	0.9287
12.9	1.098	10.6	116.5	7.275	0.9726
13.5	1.103	11.1	122.0	7.613	1.018
14.0	1.107	11.5	127.3	7.946	1.062
14.5	1.111	11.9	132.7	8.282	1.107
15.1	1.116	12.4	138.2	8.627	1.153
15.5	1.120	12.8	143.6	8.967	1.199
16.1	1.125	13.3	149.3	9.318	1.246

SODIUM SULFIDE

SPECIFIC GRAVITY OF AQUEOUS SODIUM SULFIDE SOLUTIONS AT $\frac{18^\circ}{4^\circ}$ C.*

Bé.	Sp. gr.	Per cent Na_2S	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.4	1.0098	1	10.10	0.6304	0.0843
3.0	1.0211	2	20.42	1.275	0.1704
6.1	1.0440	4	41.76	2.607	0.3485
9.1	1.0672	6	64.03	3.997	0.5344
12.1	1.0907	8	87.26	5.447	0.7282
14.9	1.1146	10	111.5	6.958	0.9302
17.7	1.1388	12	136.7	8.531	1.140
20.4	1.1634	14	162.9	10.17	1.359
23.0	1.1885	16	190.2	11.87	1.587
25.6	1.2140	18	218.5	13.64	1.824

SODIUM SULFITE

SPECIFIC GRAVITY OF AQUEOUS SODIUM SULFITE SOLUTIONS AT $\frac{19^\circ}{4^\circ}$ C.*

Bé.	Sp. gr.	Per cent Na_2SO_3	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.1	1.0078	1	10.08	0.6291	0.0841
2.5	1.0172	2	20.34	1.270	0.1698
5.1	1.0363	4	41.45	2.588	0.3459
7.6	1.0556	6	63.34	3.954	0.5286
10.1	1.0751	8	86.01	5.369	0.7178
12.6	1.0948	10	109.5	6.835	0.9136
14.9	1.1146	12	133.8	8.350	1.116
17.2	1.1346	14	158.8	9.916	1.326
19.4	1.1549	16	184.8	11.54	1.542
21.7	1.1755	18	211.6	13.21	1.766

SODIUM SULFITE ACID (SODIUM BISULFITE)

SPECIFIC GRAVITY OF AQUEOUS SODIUM ACID SULFITE SOLUTIONS AT 15° C.

Bé.	Sp. gr.	Per cent $NaHSO_3$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.2	1.008	1.6	16.13	1.007	0.1346
3.1	1.022	2.1	21.46	1.340	0.1791
5.3	1.038	3.6	37.37	2.333	0.3118
7.2	1.052	5.1	53.65	3.349	0.4477
9.2	1.068	6.5	69.42	4.334	0.5793
11.2	1.084	8.0	86.72	5.414	0.7237
13.2	1.100	9.5	104.5	6.524	0.8721
15.1	1.116	11.2	125.0	7.803	1.043
17.1	1.134	12.8	145.2	9.061	1.211
19.1	1.152	14.6	168.2	10.50	1.404
21.2	1.171	16.5	193.2	12.06	1.612
23.2	1.190	18.5	220.2	13.74	1.837
25.2	1.210	20.9	252.9	15.79	2.110
27.2	1.231	23.5	289.3	18.06	2.414
29.2	1.252	25.9	324.3	20.24	2.706
31.3	1.275	28.9	368.5	23.00	3.075
33.3	1.298	31.7	411.5	25.69	3.434
35.2	1.321	34.7	458.4	28.62	3.825
37.2	1.345	38.0	511.1	31.91	4.265

Bé.	Sp. gr.	Per cent SO_2	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.2	1.008	1.0	9.929	0.6198	0.0829
3.1	1.022	1.3	13.21	0.8248	0.1103
5.3	1.038	2.2	23.00	1.436	0.1920
7.2	1.052	3.1	33.03	2.062	0.2756
9.2	1.068	4.0	42.74	2.668	0.3566
11.2	1.084	4.9	53.39	3.333	0.4455
13.2	1.100	5.8	64.33	4.016	0.5369
15.1	1.116	6.9	76.95	4.804	0.6421
17.1	1.134	7.9	89.36	5.578	0.7457
19.1	1.152	9.0	103.5	6.464	0.8641
21.2	1.171	10.2	118.9	7.426	0.9926
23.2	1.190	11.4	135.5	8.461	1.131
25.2	1.210	12.9	155.7	9.719	1.299
27.2	1.231	14.5	178.1	11.12	1.486
29.2	1.252	15.9	199.6	12.46	1.666
31.3	1.275	17.8	226.8	14.16	1.893
33.3	1.298	19.5	253.3	15.81	2.114
35.2	1.321	21.4	282.2	17.62	2.355
37.2	1.345	23.4	314.6	19.64	2.626

SODIUM TARTRATE

Specific Gravity of Aqueous Sodium Tartrate Solutions

AT $\frac{20°}{4°}$ C.*

Bé.	Sp. gr.	Per cent $Na_2C_4H_4O_6$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.8	1.0052	1	10.05	0.6275	0.0839
1.8	1.0123	2	20.25	1.264	0.1690
3.8	1.0266	4	41.06	2.564	0.3427
5.7	1.0410	6	62.46	3.899	0.5212
7.6	1.0555	8	84.44	5.271	0.7047
9.5	1.0702	10	107.0	6.681	0.8931
11.4	1.0851	12	130.2	8.129	1.087
13.2	1.1002	14	154.0	9.616	1.285
15.0	1.1156	16	178.5	11.14	1.490
16.8	1.1313	18	203.6	12.71	1.699
18.6	1.1471	20	229.4	14.32	1.915
20.4	1.1633	22	255.9	15.98	2.136
22.1	1.1797	24	283.1	17.67	2.363
23.8	1.1963	26	311.0	19.42	2.596
25.5	1.2132	28	339.7	21.21	2.835

Bé.	Sp. gr.	Per cent $Na_2C_4H_4O_6 + 2H_2O$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.8	1.0052	1.186	11.92	0.7441	0.0995
1.8	1.0123	2.371	24.01	1.499	0.2003
3.8	1.0266	4.743	48.69	3.040	0.4063
5.7	1.0410	7.114	74.06	5.623	0.6180
7.6	1.0555	9.486	100.1	6.250	0.8355
9.5	1.0702	11.86	126.9	7.922	1.059
11.4	1.0851	14.23	154.4	9.638	1.288
13.2	1.1002	16.60	182.6	11.40	1.524
15.0	1.1156	18.97	211.6	13.21	1.766
16.8	1.1313	21.34	241.4	15.07	2.015
18.6	1.1471	23.71	272.0	16.98	2.270
20.4	1.1633	26.09	303.5	18.94	2.532
22.2	1.1797	28.46	335.7	20.96	2.802
23.8	1.1963	30.83	368.8	23.02	3.078
25.5	1.2132	33.20	402.8	25.14	3.361

SODIUM THIOSULFATE

Specific Gravity of Aqueous Sodium Thiosulfate (Hypo) Solutions at $\frac{20°}{4°}$ C.*

Bé	Sp. gr.	Per cent $Na_2S_2O_3$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.9	1.0065	1	10.07	0.6283	0.0840
2.1	1.0148	2	20.30	1.267	0.1694
4.4	1.0315	4	41.26	2.576	0.3443
6.7	1.0483	6	62.90	3.927	0.5249
8.9	1.0654	8	85.23	5.321	0.7113
11.1	1.0827	10	108.3	6.759	0.9035
13.2	1.1003	12	132.0	8.243	1.102
15.3	1.1182	14	156.5	9.773	1.306
17.4	1.1365	16	181.8	11.35	1.517
19.5	1.1551	18	207.9	12.98	1.735
21.5	1.1740	20	234.8	14.66	1.959
23.5	1.1932	22	262.5	16.39	2.191
25.4	1.2128	24	291.1	18.17	2.429
27.4	1.2328	26	320.5	20.01	2.675
29.3	1.2532	28	350.9	21.91	2.928
31.2	1.2739	30	382.2	23.86	3.189
35.8	1.3273	35	464.6	29.00	3.877
40.1	1.3827	40	553.1	34.53	4.616

Bé.	Sp. gr.	Per cent $Na_2S_2O_3 + 5H_2O$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.9	1.0065	1.570	15.80	0.9863	0.1318
2.1	1.0148	3.139	31.86	1.989	0.2659
4.4	1.0315	6.279	64.77	4.043	0.5405
6.7	1.0483	9.418	98.73	6.164	0.8239
8.9	1.0654	12.56	133.8	8.352	1.117
11.1	1.0827	15.70	170.0	10.61	1.418
13.2	1.1003	18.84	207.3	12.94	1.730
15.3	1.1182	21.98	245.7	15.34	2.051
17.4	1.1365	25.12	285.4	17.82	2.382
19.5	1.1551	28.25	326.4	20.37	2.724
21.5	1.1740	31.39	368.6	23.01	3.076
23.5	1.1932	34.53	412.1	25.72	3.439
25.4	1.2128	37.67	456.9	28.52	3.813
27.4	1.2328	40.81	503.1	31.41	4.199
29.3	1.2532	43.95	550.8	34.38	4.597
31.2	1.2739	47.09	599.9	37.45	5.006
35.8	1.3273	54.94	729.2	45.52	6.085
40.1	1.3827	62.79	868.2	54.20	7.245

SODIUM THIOSULFATE

Specific Gravity of Aqueous Sodium Thiosulfate (Hypo) Solutions at 19° C. (Schiff)

Bé.	Sp. gr.	Per cent $Na_2S_2O_3$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.8	1.0052	0.637	6.404	0.3998	0.0534
1.5	1.0105	1.27	12.88	0.8038	0.1075
2.3	1.0158	1.91	19.41	1.212	0.1620
3.0	1.0211	2.55	26.02	1.624	0.2172
3.7	1.0264	3.19	32.69	2.041	0.2728
4.5	1.0317	3.82	39.44	2.462	0.3291
5.2	1.0370	4.46	46.24	2.887	0.3859
5.9	1.0423	5.10	53.12	3.316	0.4433
6.6	1.0476	5.73	60.07	3.750	0.5013
7.3	1.0529	6.37	67.08	4.187	0.5598
8.0	1.0584	7.01	74.17	4.630	0.6190
8.7	1.0639	7.65	81.33	5.077	0.6787
9.4	1.0695	8.28	88.58	5.529	0.7392
10.1	1.0751	8.92	95.89	5.986	0.8002
10.8	1.0807	9.56	103.3	6.447	0.8618
11.5	1.0863	10.2	110.7	6.912	0.9240
12.2	1.0919	10.8	118.3	7.382	0.9869
12.9	1.0975	11.5	125.9	7.857	1.050
13.6	1.1031	12.1	133.5	8.335	1.114
14.2	1.1087	12.7	141.3	8.819	1.179
14.9	1.1145	13.4	149.1	9.308	1.244
15.6	1.1204	14.0	157.0	9.803	1.310
16.3	1.1263	14.7	165.0	10.30	1.377
16.9	1.1322	15.3	173.1	10.81	1.445
17.6	1.1381	15.9	181.3	11.32	1.513
18.3	1.1440	16.6	189.5	11.83	1.581
18.9	1.1499	17.2	197.8	12.35	1.651
19.5	1.1558	17.8	206.2	12.87	1.721
20.2	1.1617	18.5	214.6	13.40	1.791
20.8	1.1676	19.1	223.2	13.93	1.862
21.5	1.1738	19.7	231.8	14.47	1.935
22.1	1.1800	20.4	240.6	15.02	2.008
22.8	1.1862	21.0	249.4	15.57	2.081
23.4	1.1924	21.7	258.3	16.12	2.155
24.0	1.1986	22.3	267.3	16.68	2.230
24.7	1.2048	22.9	276.3	17.25	2.306
25.3	1.2110	23.6	285.5	17.82	2.382
25.9	1.2172	24.2	294.7	18.40	2.459
26.5	1.2234	24.8	304.0	18.98	2.537
27.1	1.2297	25.5	313.4	19.56	2.615
27.7	1.2362	26.1	322.9	20.16	2.695
28.3	1.2427	26.8	332.5	20.76	2.775
28.9	1.2492	27.4	342.2	21.36	2.856
29.5	1.2558	28.0	352.0	21.98	2.938
30.1	1.2624	28.7	361.9	22.59	3.020
30.7	1.2690	29.3	371.9	23.22	3.103
31.3	1.2756	29.9	381.9	23.84	3.187
31.9	1.2822	30.6	392.1	24.48	3.272
32.5	1.2888	31.2	402.3	25.12	3.357
33.1	1.2954	31.9	412.6	25.76	3.443

SODIUM THIOSULFATE

SPECIFIC GRAVITY OF AQUEOUS SODIUM THIOSULFATE SOLUTIONS AT 19° C. (SCHIFF)

Bé.	Sp. gr.	Per cent $Na_2S_2O_3 + 5H_2O$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.8	1.0052	1	10.05	0.6275	0.0839
1.5	1.0105	2	20.21	1.262	0.1687
2.3	1.0158	3	30.47	1.902	0.2543
3.0	1.0211	4	40.84	2.550	0.3409
3.7	1.0264	5	51.32	3.204	0.4283
4.5	1.0317	6	61.90	3.864	0.5166
5.2	1.0370	7	72.59	4.532	0.6058
5.9	1.0423	8	83.38	5.205	0.6959
6.6	1.0476	9	94.28	5.886	0.7868
7.3	1.0529	10	105.3	6.573	0.8787
8.0	1.0584	11	116.4	7.268	0.9716
8.7	1.0639	12	127.7	7.970	1.065
9.4	1.0695	13	139.0	8.680	1.160
10.1	1.0751	14	150.5	9.396	1.256
10.8	1.0807	15	162.1	10.12	1.353
11.5	1.0863	16	173.8	10.85	1.450
12.2	1.0919	17	185.6	11.59	1.549
12.9	1.0975	18	197.6	12.33	1.649
13.6	1.1031	19	209.6	13.08	1.749
14.2	1.1087	20	221.7	13.84	1.850
14.9	1.1145	21	234.0	14.61	1.953
15.6	1.1204	22	246.5	15.39	2.057
16.3	1.1263	23	259.0	16.17	2.162
16.9	1.1322	24	271.7	16.96	2.268
17.6	1.1381	25	284.5	17.76	2.374
18.3	1.1440	26	297.4	18.57	2.482
18.9	1.1499	27	310.4	19.38	2.591
19.5	1.1558	28	323.6	20.20	2.701
20.2	1.1617	29	336.9	21.03	2.811
20.8	1.1676	30	350.3	21.87	2.923
21.5	1.1738	31	363.9	22.72	3.037
22.1	1.1800	32	377.6	23.57	3.151
22.8	1.1862	33	391.4	24.44	3.267
23.4	1.1924	34	405.4	25.31	3.383
24.0	1.1986	35	419.5	26.19	3.501
24.7	1.2048	36	433.7	27.08	3.620
25.3	1.2110	37	448.1	27.97	3.739
25.9	1.2172	38	462.5	28.87	3.860
26.5	1.2234	39	477.1	29.79	3.982
27.1	1.2297	40	491.9	30.71	4.105
27.7	1.2362	41	506.8	31.64	4.230
28.3	1.2427	42	521.9	32.58	4.356
28.9	1.2492	43	537.2	33.53	4.483
29.5	1.2558	44	552.6	34.49	4.611
30.1	1.2624	45	568.1	35.46	4.741
30.7	1.2690	46	583.7	36.44	4.871
31.3	1.2756	47	599.5	37.43	5.003
31.9	1.2822	48	615.5	38.42	5.136
32.5	1.2888	49	631.5	39.42	5.270
33.1	1.2954	50	647.7	40.43	5.405

STANNIC CHLORIDE

Specific Gravity of Aqueous Stannic Chloride Solutions at $\frac{15^\circ}{4^\circ}$ C.*

Bé.	Sp. gr.	Per cent $SnCl_4$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.0	1.007	1	10.07	0.6286	0.0840
2.1	1.015	2	20.30	1.267	0.1694
4.4	1.031	4	41.24	2.574	0.3442
6.5	1.047	6	62.82	3.922	0.5243
8.7	1.064	8	85.12	5.314	0.7103
10.9	1.081	10	108.1	6.748	0.9021
13.1	1.099	12	131.9	8.233	1.101
15.2	1.117	14	156.4	9.762	1.305
17.2	1.135	16	181.6	11.34	1.515
19.4	1.154	18	207.7	12.97	1.733
21.4	1.173	20	234.6	14.65	1.958
23.4	1.192	22	262.2	16.37	2.188
25.4	1.212	24	290.9	18.16	2.427
27.4	1.233	26	320.6	20.01	2.675
29.5	1.255	28	351.4	21.94	2.933
31.5	1.278	30	383.4	23.93	3.200
36.6	1.337	35	468.0	29.21	3.905
41.7	1.403	40	561.2	35.03	4.683
46.7	1.475	45	663.8	41.44	5.539
51.8	1.555	50	777.5	48.54	6.488
56.8	1.644	55	904.2	56.45	7.546
61.8	1.742	60	1045	65.25	8.722
66.7	1.851	65	1203	75.11	10.04
71.4	1.971	70	1380	86.13	11.51

Bé.	Sp. gr.	Per cent $SnCl_4 + 5H_2O$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.0	1.007	1.35	13.55	0.8460	0.1131
2.1	1.015	2.69	27.32	1.705	0.2280
4.4	1.031	5.38	55.50	3.465	0.4632
6.5	1.047	8.07	84.54	5.278	0.7055
8.7	1.064	10.8	114.5	7.151	0.9560
10.9	1.081	13.5	145.5	9.082	1.214
13.1	1.099	16.1	177.5	11.08	1.481
15.2	1.117	18.8	210.4	13.14	1.756
17.2	1.135	21.5	244.4	15.26	2.039
19.4	1.154	24.2	279.5	17.45	2.333
21.4	1.173	26.9	315.8	19.71	2.635
23.4	1.192	29.6	352.9	22.03	2.945
25.4	1.212	32.3	391.5	24.44	3.267
27.4	1.233	35.0	431.4	26.93	3.600
29.5	1.255	37.7	472.9	29.52	3.946
31.5	1.278	40.4	516.0	32.21	4.306
36.6	1.337	47.1	629.7	39.31	5.255
41.7	1.403	53.8	755.2	47.15	6.303
46.7	1.475	60.6	893.2	55.78	7.454
51.8	1.555	67.3	1046	65.32	8.732
56.8	1.644	74.0	1217	75.96	10.15
61.8	1.742	80.7	1407	87.81	11.74
66.7	1.851	87.5	1619	101.1	13.51
71.4	1.971	94.2	1857	115.9	15.49

STANNOUS CHLORIDE

Specific Gravity of Aqueous Stannous Chloride Solutions at $\frac{15°}{4°}$ C.*

Bé.	Sp. gr.	Per cent $SnCl_2$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.0	1.0068	1	10.07	0.6285	0.0840
2.1	1.0146	2	20.29	1.267	0.1693
4.3	1.0306	4	41.22	2.573	0.3440
6.5	1.0470	6	62.82	3.922	0.5243
8.7	1.0638	8	85.10	5.313	0.7102
10.9	1.0810	10	108.1	6.748	0.9021
13.0	1.0986	12	131.8	8.230	1.100
15.2	1.1167	14	156.3	9.760	1.305
17.3	1.1353	16	181.6	11.34	1.516
19.4	1.1545	18	207.8	12.97	1.734
21.5	1.1743	20	234.9	14.66	1.960
23.6	1.1948	22	262.9	16.41	2.194
25.8	1.2159	24	291.8	18.22	2.435
27.8	1.2377	26	321.8	20.09	2.686
29.9	1.2603	28	352.9	22.03	2.945
32.0	1.2837	30	385.1	24.04	3.214
37.3	1.3461	35	471.1	29.41	3.932
42.5	1.4145	40	565.8	35.32	4.722
47.7	1.4897	45	670.4	41.85	5.594
52.8	1.5729	50	786.5	49.10	6.563
57.9	1.6656	55	916.1	57.19	7.645
63.1	1.7695	60	1062	66.28	8.860
68.1	1.8865	65	1226	76.55	10.23

Bé.	Sp. gr.	Per cent $SnCl_2 + 2H_2O$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.0	1.0068	1.19	11.98	0.7480	0.1000
2.1	1.0146	2.38	24.15	1.508	0.2015
4.3	1.0306	4.76	49.06	3.063	0.4094
6.5	1.0470	7.14	74.76	4.667	0.6239
8.7	1.0638	9.52	101.3	6.322	0.8452
10.9	1.0810	11.9	128.6	8.031	1.074
13.0	1.0986	14.3	156.9	9.794	1.309
15.2	1.1167	16.7	186.0	11.61	1.553
17.3	1.1353	19.0	216.2	13.49	1.804
19.4	1.1545	21.4	247.3	15.44	2.064
21.5	1.1743	23.8	279.5	17.45	2.332
23.6	1.1948	26.2	312.8	19.53	2.610
25.8	1.2159	28.6	347.3	21.68	2.898
27.8	1.2377	30.9	383.0	23.91	3.196
29.9	1.2603	33.3	419.9	26.22	3.505
32.0	1.2837	35.7	458.3	28.61	3.825
37.3	1.3461	41.7	560.7	35.00	4.679
42.5	1.4145	47.6	673.3	42.03	5.619
47.7	1.4897	53.6	797.8	49.80	6.657
52.8	1.5729	59.5	935.9	58.43	7.810
57.9	1.6656	65.5	1090	68.06	9.098
63.1	1.7695	71.4	1263	78.87	10.54
68.1	1.8865	77.4	1459	91.10	12.18

SULFURIC ACID

Specific Gravity of Aqueous Sulfuric Acid Solutions

AT $\frac{20°}{4°}$ C.*

Bé.	Sp. gr.	Per cent H_2SO_4	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.7	1.0051	1	10.05	0.6275	0.0839
1.7	1.0118	2	20.24	1.263	0.1689
2.6	1.0184	3	30.55	1.907	0.2550
3.5	1.0250	4	41.00	2.560	0.3422
4.5	1.0137	5	51.59	3.220	0.4305
5.4	1.0385	6	62.31	3.890	0.5200
6.3	1.0453	7	73.17	4.568	0.6106
7.2	1.0522	8	84.18	5.255	0.7025
8.1	1.0591	9	95.32	5.950	0.7955
9.0	1.0661	10	106.6	6.655	0.8897
9.9	1.0731	11	118.0	7.369	0.9851
10.8	1.0802	12	129.6	8.092	1.082
11.7	1.0874	13	141.4	8.825	1.180
12.5	1.0947	14	153.3	9.567	1.279
13.4	1.1020	15	165.3	10.32	1.379
14.3	1.1094	16	177.5	11.08	1.481
15.2	1.1168	17	189.9	11.85	1.584
16.0	1.1243	18	202.4	12.63	1.689
16.9	1.1318	19	215.0	13.42	1.795
17.7	1.1394	20	227.9	14.23	1.902
18.6	1.1471	21	240.9	15.04	2.010
19.4	1.1548	22	254.1	15.86	2.120
20.3	1.1626	23	267.4	16.69	2.231
21.1	1.1704	24	280.9	17.54	2.344
21.9	1.1783	25	294.6	18.39	2.458
22.8	1.1862	26	308.4	19.25	2.574
23.6	1.1942	27	322.4	20.13	2.691
24.4	1.2023	28	336.6	21.02	2.809
25.2	1.2104	29	351.0	21.91	2.929
26.0	1.2185	30	365.6	22.82	3.051
26.8	1.2267	31	380.3	23.74	3.173
27.6	1.2349	32	395.2	24.67	3.298
28.4	1.2432	33	410.3	25.61	3.424
29.1	1.2515	34	425.5	26.56	3.551
29.9	1.2599	35	441.0	27.53	3.680
30.7	1.2684	36	456.6	28.51	3.811
31.4	1.2769	37	472.5	29.49	3.943
32.2	1.2855	38	488.5	30.49	4.077
33.0	1.2941	39	504.7	31.51	4.212
33.7	1.3028	40	521.1	32.53	4.349
34.5	1.3116	41	537.8	33.57	4.488
35.2	1.3205	42	554.6	34.62	4.628
35.9	1.3294	43	571.6	35.69	4.770
36.7	1.3384	44	588.9	36.76	4.914
37.4	1.3476	45	606.4	37.86	5.061
38.1	1.3569	46	624.2	38.97	5.209
38.9	1.3663	47	642.2	40.09	5.359
39.6	1.3758	48	660.4	41.23	5.511
40.3	1.3854	49	678.8	42.38	5.665
41.1	1.3951	50	697.6	43.55	5.821
41.8	1.4049	51	716.5	44.73	5.979
42.5	1.4148	52	735.7	45.93	6.140
43.2	1.4248	53	755.1	47.14	6.302
44.0	1.4350	54	774.9	48.37	6.467

SULFURIC ACID (Continued)

Specific Gravity of Aqueous Sulfuric Acid Solutions at $\frac{20°}{4°}$ C.*

Bé.	Sp. gr.	Per cent H_2SO_4	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
44.7	1.4453	55	794.9	49.62	6.634
45.4	1.4557	56	815.2	50.89	6.803
46.1	1.4662	57	835.7	52.17	6.974
46.8	1.4768	58	856.5	53.47	7.148
47.5	1.4875	59	877.6	54.79	7.324
48.2	1.4983	60	899.0	56.12	7.502
48.9	1.5091	61	920.6	57.47	7.682
49.6	1.5200	62	942.4	58.83	7.865
50.3	1.5310	63	964.5	60.21	8.049
51.0	1.5421	64	986.9	61.61	8.236
51.7	1.5533	65	1010	63.03	8.426
52.3	1.5646	66	1033	64.46	8.618
53.0	1.5760	67	1056	65.92	8.812
53.7	1.5874	68	1079	67.39	9.008
54.3	1.5989	69	1103	68.87	9.207
55.0	1.6105	70	1127	70.38	9.408
55.6	1.6221	71	1152	71.90	9.611
56.3	1.6338	72	1176	73.44	9.817
56.9	1.6456	73	1201	74.99	10.02
57.5	1.6574	74	1226	76.57	10.24
58.1	1.6692	75	1252	78.15	10.45
58.7	1.6810	76	1278	79.75	10.66
59.3	1.6927	77	1303	81.37	10.88
59.9	1.7043	78	1329	82.99	11.09
60.5	1.7158	79	1355	84.62	11.31
61.1	1.7272	80	1382	86.26	11.53
61.6	1.7383	81	1408	87.90	11.75
62.1	1.7491	82	1434	89.54	11.97
62.6	1.7594	83	1460	91.16	12.19
63.0	1.7693	84	1486	92.78	12.40
63.5	1.7786	85	1512	94.38	12.62
63.9	1.7872	86	1537	95.95	12.83
64.2	1.7951	87	1562	97.49	13.03
64.5	1.8022	88	1586	99.01	13.23
64.8	1.8087	89	1610	100.5	13.43
65.1	1.8144	90	1633	101.9	13.63
65.3	1.8195	91	1656	103.4	13.82
65.5	1.8240	92	1678	104.8	14.00
65.7	1.8279	93	1700	106.1	14.19
65.8	1.8312	94	1721	107.5	14.36
65.9	1.8337	95	1742	108.7	14.54
66.0	1.8355	96	1762	110.0	14.70
66.0	1.8364	97	1781	111.2	14.87
66.0	1.8361	98	1799	112.3	15.02
65.9	1.8342	99	1816	113.4	15.15
65.8	1.8305	100	1831	114.3	15.28

TABLES OF THE MANUFACTURING CHEMISTS' ASSOCIATION

SULFURIC ACID

Authorities — W. C. Ferguson; H. P. Talbot

This table has been approved and adopted as a standard by the Manufacturing Chemists' Association of the United States.

Specific Gravity determinations were made at 60° F., compared with water at 60° F.

From the Specific Gravities the corresponding degrees Baumé were calculated by the following formula:

$$\text{Baumé} = 145 - \frac{145}{\text{Sp. Gr.}}.$$

Baumé Hydrometers for use with this table must be graduated by the above formula, which formula should always be printed on the scale.

66° Baumé = Sp. Gr. 1.8354.

1 cu. ft. water at 60° F. weighs 62.37 lbs. av.

Atomic weights from F. W. Clarke's table of 1901. O = 16.

H_2SO_4 = 100 per cent.

	H_2SO_4	O. V.	60°
O. V.	93.19	100.00	119.98
60°	77.67	83.35	100.00
50°	62.18	66.72	80.06

Acids stronger than 66° Bé. should have their percentage compositions determined by chemical analysis.

Bé.°	Sp. gr.	Tw.°	Per cent H_2SO	Weight of 1 cu. ft. in lbs. av.	Per cent O. V.	Pounds O. V. in 1 cu. ft.	* Freezing (melting) point.
0	1.0000	0.0	0.00	62.37	0.00	0.00	32.0° F
1	1.0069	1.4	1.02	62.80	1.09	.68	31.2 "
2	1.0140	2.8	2.08	63.24	2.23	1.41	30.5 "
3	1.0211	4.2	3.13	63.69	3.36	2.14	29.8 "
4	1.0284	5.7	4.21	64.14	4.52	2.90	28.9 "
5	1.0357	7.1	5.28	64.60	5.67	3.66	28.1 "
6	1.0432	8.6	6.37	65.06	6.84	4.45	27.2 "
7	1.0507	10.1	7.45	65.53	7.99	5.24	26.3 "
8	1.0584	11.7	8.55	66.01	9.17	6.06	25.1 "
9	1.0662	13.2	9.66	66.50	10.37	6.89	24.0 "
10	1.0741	14.8	10.77	66.99	11.56	7.74	22.8 "
11	1.0821	16.4	11.89	67.49	12.76	8.61	21.5 "
12	1.0902	18.0	13.01	68.00	13.96	9.49	20.0 "
13	1.0985	19.7	14.13	68.51	15.16	10.39	18.3 "
14	1.1069	21.4	15.25	69.04	16.36	11.30	16.6 "

* Calculated from Pickering's results, Journal of London Chemical Society vol. 57, p. 363.

SULFURIC ACID (Continued)

Bé.°	Sp. gr.	Tw.°	Per cent H_2SO_4	Weight of 1 cu. ft. in lbs. av.	Per cent O. V.	Pounds O. V. in 1 cu.ft.	* Freezing (melting) point.
15	1.1154	23.1	16.38	69.57	17.58	12.23	14.7 F.
16	1.1240	24.8	17.53	70.10	18.81	13.19	12.6 "
17	1.1328	26.6	18.71	70.65	20.08	14.18	10.2 "
18	1.1417	28.3	19.89	71.21	21.34	15.20	7.7 "
19	1.1508	30.2	21.07	71.78	22.61	16.23	4.8 "
20	1.1600	32.0	22.25	72.35	23.87	17.27	+ 1.6 "
21	1.1694	33.9	23.43	72.94	25.14	18.34	− 1.8 "
22	1.1789	35.8	24.61	73.53	26.41	19.42	− 6.0 "
23	1.1885	37.7	25.81	74.13	27.69	20.53	−11 "
24	1.1983	39.7	27.03	74.74	29.00	21.68	−16 "
25	1.2083	41.7	28.28	75.36	30.34	22.87	−23 "
26	1.2185	43.7	29.53	76.00	31.69	24.08	−30 "
27	1.2288	45.8	30.79	76.64	33.04	25.32	−39 "
28	1.2393	47.9	32.05	77.30	34.39	26.58	−49 "
29	1.2500	50.0	33.33	77.96	35.76	27.88	−61 "
30	1.2609	52.2	34.63	78.64	37.16	29.22	−74 "
31	1.2719	54.4	35.93	79.33	38.55	30.58	−82 "
32	1.2832	56.6	37.26	80.03	39.98	32.00	−96 "
33	1.2946	58.9	38.58	80.74	41.40	33.42	−97 "
34	1.3063	61.3	39.92	81.47	42.83	34.90	−91 "
35	1.3182	63.6	41.27	82.22	44.28	36.41	−81 "
36	1.3303	66.1	42.63	82.97	45.74	37.95	−70 "
37	1.3426	68.5	43.99	83.74	47.20	39.53	−60 "
38	1.3551	71.0	45.35	84.52	48.66	41.13	−53 "
39	1.3679	73.6	46.72	85.32	50.13	42.77	−47 "
40	1.3810	76.2	48.10	86.13	51.61	44.45	−41 "
41	1.3942	78.8	49.47	86.96	53.08	46.16	−35 "
42	1.4078	81.6	50.87	87.80	54.58	47.92	−31 "
43	1.4216	84.3	52.26	88.67	56.07	49.72	−27 "
44	1.4356	87.1	53.66	89.54	57.58	51.56	−23 "
45	1.4500	90.0	55.07	90.44	59.09	53.44	−20 "
46	1.4646	92.9	56.48	91.35	60.60	55.36	−14 "
47	1.4796	95.9	57.90	92.28	62.13	57.33	−15 "
48	1.4948	99.0	59.32	93.23	63.65	59.34	−18 "
49	1.5104	102.1	60.75	94.20	65.18	61.40	−22 "

* Calculated from Pickering's results, Journal of London Chemical Society ol. 57, p. 363.

SULFURIC ACID (Continued)

Bé.°	Sp. gr.	Tw.°	Per cent H_2SO_4	Weight of 1 cu. ft. in lbs. av.	Per cent O. V.	Pounds O. V. in 1 cu.ft.	*Freezing (melting) point.	
50	1.5263	105.3	62.15	96.20	66.72	63.52	−27	F.
51	1.5426	108.5	63.66	96.21	68.31	65.72	−33	"
52	1.5591	111.8	65.13	97.24	69.89	67.96	−39	"
53	1.5761	115.2	66.63	98.30	71.50	70.28	−49	"
54	1.5934	118.7	68.13	99.33	73.11	72.66	−59	"
55	1.6111	122.2	69.65	100.48	74.74	75.10	..	Below −40
56	1.6292	125.8	71.17	101.61	76.37	77.60	..	
57	1.6477	129.5	72.75	102.77	78.07	80.23	..	
58	1.6667	133.3	74.36	103.95	79.79	82.95	..	
59	1.6860	137.2	75.99	105.16	81.54	85.75	− 7	
60	1.7059	141.2	77.67	106.40	83.35	88.68	+12.6	F.
61	1.7262	145.2	79.43	107.66	85.23	91.76	27.3	"
62	1.7470	149.4	81.30	108.96	87.24	95.06	39.1	"
63	1.7683	153.7	83.34	110.29	89.43	98.63	46.1	"
64	1.7901	158.0	85.66	111.65	91.92	102.63	46.4	"
64¼	1.7957	159.1	86.33	112.00	92.64	103.75	43.6	"
64½	1.8012	150.2	87.04	112.34	93.40	104.93	41.1	"
64¾	1.8068	161.4	87.81	112.69	94.23	106.19	37.9	"
65	1.8125	162.5	88.65	113.05	95.13	107.54	33.1	"
65¼	1.8182	163.6	89.55	113.40	96.10	108.97	24.6	"
65½	1.8239	164.8	90.60	113.76	97.22	110.60	13.4	"
65¾	1.8297	165.9	91.80	114.12	98.51	112.42	− 1	"
66	1.8354	167.1	93.19	114.47	10.00	114.47	−29	"

* Calculated from Pickering's results, Journal of London Chemical Society vol. 57, p. 363.

APPROXIMATE BOILING POINTS

50° Bé.	295	F.
60° "	386	"
61° "	400	"
62° "	415	"
63° "	432	"
64° "	451	"
65° "	485	"
66° "	538	"

Per cent 60°	Pounds 60° in 1 cu. ft.	Per cent 50°	Pounds 50° in 1 cu. ft.
61.93	53.34	77.36	66.6
63.69	55.39	79.56	69.1
65.50	57.50	81.81	71.8
67.28	59.66	84.05	74.5
69.09	61.86	86.30	77.2
70.90	64.12	88.56	80.1
72.72	66.43	90.83	82.9
74.55	68.79	93.12	85.9
76.37	71.20	95.40	88.9
78.22	73.68	97.70	92.0

SULFURIC ACID (Continued)

FIXED POINTS

Sp. gr.	Per cent H_2SO_4	Sp. gr.	Per cent H_2SO_4	Per cent 60°	Pounds 60° in 1 cu. ft.	Per cent 50°	Pounds 50° in 1 cu. ft
1.0000	.00	1.5281	62.34	80.06	76.21	100.00	95.20
1.0048	.71	1.5440	63.79	81.96	78.85	102.38	98.50
1.0347	5.14	1.5748	66.51				
1.0649	9.48	1.6272	71.00	83.86	81.54	104.74	101.85
1.0992	14.22	1.6679	74.46	85.79	84.33	107.15	105.33
1.1353	19.04	1.7044	77.54	87.72	87.17	109.57	108.89
1.1736	23.94	1.7258	79.40				
1.2105	28.55	1.7472	81.32	89.67	90.10	112.01	112.55
1.2513	33.49	1.7700	83.47	91.63	93.11	114.46	116.30
1.2951	38.64	1.7959	86.36	93.67	96.26	117.00	120.24
1.3441	44.15	1.8117	88.53	95.74	99.52	119.59	124.31
1.3947	49.52	1.8194	89.75	97.84	102.89	122.21	128.52
1.4307	53.17	1.8275	91.32				
1.4667	56.68	1.8354	93.19	100.00	106.40	124.91	132.91
1.4822	58.14			102.27	110.10	127.74	137.52
				104.67	114.05	130.75	142.47
				107.30	118.34	134.03	147.82
				110.29	123.14	137.76	153.81
				111.15	124.49	138.84	155.50
				112.06	125.89	139.98	157.25
				113.05	127.40	141.22	159.14
				114.14	129.03	142.57	161.17
				115.30	130.75	144.02	163.32
				116.65	132.70	145.71	165.76
				118.19	134.88	147.63	168.48
				119.98	137.34	149.87	171.56

ALLOWANCE FOR TEMPERATURE

At 10° Bé. .029° Bé. or .00023 Sp. Gr. = 1° F.
At 20° Bé. .036° Bé. or .00034 Sp. Gr. = 1° F.
At 30° Bé. .035° Bé. or .00039 Sp. Gr. = 1° F.
At 40° Bé. .031° Bé. or .00041 Sp. Gr. = 1° F.
At 50° Bé. .028° Bé. or .00045 Sp. Gr. = 1° F.
At 60° Bé. .026° Bé. or .00053 Sp. Gr. = 1° F.
At 63° Bé. .026° Bé. or .00057 Sp. Gr. = 1° F.
At 66° Bé. .0235° Bé. or .00054 Sp. Gr. = 1° F.

SULFURIC ACID, SO_3

SPECIFIC GRAVITY OF AQUEOUS SULFURIC ACID SOLUTIONS AT $\frac{20°}{4°}$ C. GIVING SO_3 CONTENT

Bé.	Sp. gr.	Per cent SO_3	G. per liter SO_3	Lbs. per cu. ft. SO_3	Lbs per gal. SO_3
0.7	1.0051	.8163	8.204	.5122	0.0685
1.7	1.0118	1.633	16.52	1.030	.1379
2.6	1.0184	2.449	24.94	1.557	.2082
3.5	1.0250	3.265	33.47	2.090	.2793
4.5	1.0137	4.082	42.11	2.628	.3514
5.4	1.0385	4.898	50.86	3.175	.4245
6.3	1.0453	5.714	59.73	3.729	.4984
7.2	1.0522	6.531	68.72	4.290	.5735
8.1	1.0591	7.347	77.81	4.857	.6494
9.0	1.0661	8.163	87.02	5.433	.7263
9.9	1.0731	8.979	96.32	6.015	.8042
10.8	1.0802	9.796	105.8	6.606	.8833
11.7	1.0874	10.612	115.4	7.204	.9633
12.5	1.0947	11.43	125.1	7.810	1.044
13.4	1.1020	12.24	134.9	8.424	1.126
14.3	1.1094	13.06	144.9	9.045	1.209
15.2	1.1168	13.88	155.0	9.673	1.293
16.0	1.1243	14.69	165.2	10.31	1.379
16.9	1.1318	15.51	175.5	10.95	1.465
17.7	1.1394	16.33	186.0	11.62	1.553
18.6	1.1471	17.14	196.6	12.28	1.641
19.4	1.1548	17.96	207.4	12.95	1.731
20.3	1.1626	18.78	218.3	13.62	1.821
21.1	1.1704	19.59	229.3	14.32	1.913
21.9	1.1783	20.41	240.5	15.01	2.007
22.8	1.1862	21.22	251.8	15.71	2.101
23.6	1.1942	22.04	263.2	16.43	2.197
24.4	1.2023	22.86	274.8	17.16	2.293
25.2	1.2104	23.67	286.5	17.89	2.391
26.0	1.2185	24.49	298.4	18.63	2.491
26.8	1.2267	25.31	310.4	19.38	2.590
27.6	1.2349	26.12	322.6	20.14	2.692
28.4	1.2432	26.94	334.9	20.91	2.795
29.1	1.2515	27.75	347.3	21.68	2.899
29.9	1.2599	28.57	360.0	22.47	3.003
30.7	1.2684	29.39	372.7	23.27	3.111
31.4	1.2769	30.20	385.7	24.07	3.219
32.2	1.2855	31.02	398.8	24.89	3.328
33.0	1.2941	31.84	412.0	25.72	3.438
33.7	1.3028	32.65	425.4	26.45	3.550
34.5	1.3116	33.47	439.0	27.40	3.664
35.2	1.3205	34.29	452.7	28.26	3.778
35.9	1.3294	35.10	466.6	29.13	3.894
36.7	1.3384	35.92	480.7	30.01	4.011
37.4	1.3476	36.73	495.0	30.91	4.131
38.1	1.3569	37.55	509.5	31.81	4.252
38.9	1.3663	38.37	524.2	32.73	4.375
39.6	1.3758	39.18	539.1	33.66	4.499
40.3	1.3854	40.00	554.1	34.50	4.624
41.1	1.3951	40.82	569.5	35.55	4.752
41.8	1.4049	41.63	584.9	36.51	4.881
42.5	1.4148	42.45	600.6	37.49	5.012
43.2	1.4248	43.26	616.4	38.48	5.144
44.0	1.4350	44.08	632.6	39.49	5.279
44.7	1.4453	44.90	648.9	40.51	5.415
45.4	1.4557	45.71	665.5	41.54	5.553

SULFURIC ACID SO_3 (Continued)

Specific Gravity of Aqueous Sulfuric Acid Solutions at $\frac{20°}{4°}$ C. Giving SO_3 Content

Bé.	Sp. gr.	Per cent SO_3	G. per liter SO_3	Lbs. per cu. ft. SO_3	Lbs. per gal. SO_3
46.1	1.4662	46.53	682.2	42.59	5.693
46.8	1.4768	47.35	699.2	43.65	5.835
47.5	1.4875	48.16	716.4	44.73	5.979
48.2	1.4983	48.98	733.9	45.81	6.124
48.9	1.5091	49.80	751.5	46.91	6.271
49.6	1.5200	50.61	769.3	48.02	6.420
50.3	1.5310	51.43	787.3	49.15	6.571
51.0	1.5421	52.24	805.6	50.29	6.723
51.7	1.5533	53.06	824.5	51.45	6.878
52.3	1.5646	53.88	843.3	52.62	7.035
53.0	1.5760	54.69	862.0	53.81	7.193
53.7	1.5874	55.51	880.8	55.01	7.353
54.3	1.5989	56.33	900.4	56.22	7.516
55.0	1.6105	57.14	920.0	57.45	7.680
55.6	1.6221	57.96	940.4	58.69	7.846
56.3	1.6338	58.77	960.0	59.95	8.014
56.9	1.6456	59.59	980.4	61.22	8.180
57.5	1.6574	60.41	1001	62.51	8.359
58.1	1.6692	61.22	1022	63.80	8.530
58.7	1.6810	62.04	1043	65.10	8.702
59.3	1.6927	62.86	1064	66.42	8.882
59.9	1.7043	63.67	1085	67.75	9.053
60.5	1.7158	64.49	1106	69.08	9.233
61.1	1.7272	65.31	1128	70.42	9.412
61.6	1.7383	66.12	1149	71.75	9.592
62.1	1.7491	66.94	1171	73.09	9.771
62.6	1.7594	67.75	1192	74.42	9.951
63.0	1.7693	68.57	1213	75.74	10.12
63.5	1.7786	69.39	1234	77.04	10.30
63.9	1.7872	70.20	1255	78.33	10.47
64.2	1.7951	71.02	1275	79.58	10.64
64.5	1.8022	71.84	1295	80.82	10.80
64.8	1.8087	72.65	1314	82.04	10.96
65.1	1.8144	73.47	1333	83.18	11.13
65.3	1.8195	74.28	1352	84.41	11.28
65.5	1.8240	75.10	1370	85.55	11.43
65.7	1.8279	75.92	1388	86.61	11.58
65.8	1.8312	76.73	1405	87.75	11.72
65.9	1.8337	77.55	1422	88.73	11.87
66.0	1.8355	78.37	1438	89.79	12.00
66.0	1.8364	79.18	1454	90.77	12.14
66.0	1.8361	80.00	1468	91.67	12.26
65.9	1.8342	80.82	1482	92.57	12.37
65.8	1.8305	81.63	1495	93.31	12.47

TANNIC ACID

SPECIFIC GRAVITY OF AQUEOUS TANNIC ACID SOLUTIONS AT 15° C. (TRAMMER)

Bé.	Sp. gr.	Per cent $C_{14}H_{10}O_9$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.6	1.0040	1.0	10.04	0.6268	0.0838
0.6	1.0044	1.0	11.05	0.6897	0.0922
0.7	1.0048	1.2	12.06	0.7527	0.1006
0.8	1.0052	1.3	13.07	0.8158	0.1091
0.8	1.0056	1.4	14.08	0.8789	0.1175
0.9	1.0060	1.5	15.09	0.9420	0.1259
0.9	1.0064	1.6	16.10	1.005	0.1344
1.0	1.0068	1.7	17.12	1.068	0.1428
1.0	1.0072	1.8	18.13	1.132	0.1513
1.1	1.0076	1.9	19.14	1.195	0.1598
1.2	1.0080	2.0	20.16	1.259	0.1682
1.2	1.0084	2.1	21.18	1.322	0.1767
1.3	1.0088	2.2	22.19	1.385	0.1852
1.3	1.0092	2.3	23.21	1.449	0.1937
1.4	1.0096	2.4	24.23	1.513	0.2022
1.4	1.0100	2.5	25.25	1.576	0.2107
1.5	1.0104	2.6	26.27	1.640	0.2192
1.5	1.0108	2.7	27.29	1.704	0.2278
1.6	1.0112	2.8	28.31	1.768	0.2363
1.7	1.0116	2.9	29.34	1.831	0.2448
1.7	1.0120	3.0	30.36	1.895	0.2534
1.8	1.0124	3.1	31.38	1.959	0.2619
1.8	1.0128	3.2	32.41	2.023	0.2705
1.9	1.0132	3.3	33.44	2.087	0.2790
1.9	1.0136	3.4	34.46	2.151	0.2876
2.0	1.0140	3.5	35.49	2.216	0.2962
2.1	1.0144	3.6	36.52	2.280	0.3048
2.1	1.0148	3.7	37.55	2.344	0.3133
2.2	1.0152	3.8	38.58	2.408	0.3219
2.2	1.0156	3.9	39.61	2.473	0.3305
2.3	1.0160	4.0	40.64	2.537	0.3392
2.3	1.0164	4.1	41.67	2.601	0.3478
2.4	1.0168	4.2	42.71	2.666	0.3564
2.5	1.0172	4.3	43.74	2.731	0.3650
2.5	1.0176	4.4	44.77	2.795	0.3737
2.6	1.0180	4.5	45.81	2.860	0.3823
2.6	1.0184	4.6	46.85	2.924	0.3909
2.7	1.0188	4.7	47.88	2.989	0.3996
2.7	1.0192	4.8	48.92	3.054	0.4083
2.8	1.0196	4.9	49.96	3.119	0.4169
2.8	1.0200	5.0	51.00	3.184	0.4256
5.6	1.0401	10.0	104.0	6.493	0.8680

TARTARIC ACID

SPECIFIC GRAVITY OF AQUEOUS TARTARIC ACID (D) SOLUTIONS AT 15° C. (GERLACH)

Bé.	Sp. gr.	Per cent $H_2C_4H_4O_6$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.6	1.0045	1	10.05	0.6271	0.0838
1.3	1.0090	2	20.18	1.260	0.1684
2.6	1.0179	4	40.72	2.542	0.3398
3.9	1.0273	6	61.64	3.848	0.5144
5.2	1.0371	8	82.97	5.179	0.6924
6.5	1.0469	10	104.7	6.535	0.8737
7.8	1.0565	12	126.8	7.915	1.058
9.0	1.0661	14	149.3	9.317	1.246
10.3	1.0761	16	172.2	10.75	1.437
11.5	1.0865	18	195.6	12.21	1.632
12.8	1.0969	20	219.4	13.70	1.831
14.0	1.1072	22	243.6	15.21	2.033
15.2	1.1175	24	268.2	16.74	2.238
16.5	1.1282	26	293.3	18.31	2.448
17.7	1.1393	28	319.0	19.91	2.662
19.0	1.1505	30	345.2	21.55	2.880
20.2	1.1615	32	371.7	23.20	3.102
21.3	1.1726	34	398.7	24.89	3.327
22.5	1.1840	36	426.2	26.61	3.557
23.8	1.1959	38	454.4	28.37	3.792
25.0	1.2078	40	483.1	30.16	4.032
26.1	1.2198	42	512.3	31.98	4.275
27.3	1.2317	44	541.9	33.83	4.523
28.5	1.2441	46	572.3	35.73	4.776
29.6	1.2568	48	603.3	37.66	5.034
30.8	1.2696	50	634.8	39.63	5.298
32.0	1.2828	52	667.1	41.64	5.567
33.1	1.2961	54	699.9	43.69	5.841
34.3	1.3093	56	733.2	45.77	6.119

ZINC CHLORIDE

Specific Gravity of Aqueous Zinc Chloride Solutions at $\frac{20°}{4°}$ C.*

Bé.	Sp. gr.	Per cent $ZnCl_2$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
2.4	1.0167	2	20.33	1.269	0.1697
4.9	1.0350	4	41.40	2.584	0.3455
7.3	1.0532	6	63.19	3.945	0.5274
9.7	1.0715	8	85.72	5.351	0.7154
11.0	1.0819	10	108.2	6.754	0.9029
14.2	1.1085	12	133.0	8.304	1.110
16.4	1.1275	14	157.9	9.854	1.317
18.6	1.1468	16	183.5	11.45	1.531
20.7	1.1665	18	210.0	13.11	1.752
22.8	1.1866	20	237.3	14.82	1.980
27.9	1.2380	25	309.5	19.32	2.583
32.8	1.2928	30	387.8	24.21	3.237
37.8	1.3522	35	473.3	29.54	3.950
42.7	1.4173	40	566.9	35.39	4.731
47.6	1.4890	45	670.1	41.83	5.592
52.5	1.5681	50	784.1	48.95	6.543
57.4	1.655	55	910.3	56.82	7.596
62.1	1.749	60	1049	65.51	8.757
66.7	1.851	65	1203	75.11	10.05
71.1	1.962	70	1373	85.74	11.46

ZINC CHLORIDE

SPECIFIC GRAVITY OF AQUEOUS ZINC CHLORIDE SOLUTIONS AT $\frac{60°}{60°}$ F. (WHITNEY, HARTLE, SAKRYD)

Bé.	Sp. gr.	Per cent $ZnCl_2$	Weight of 1 cu. ft. in lbs.	Lbs. $ZnCl_2$ in 1 cu. ft.	Per cent 50 per cent $ZnCl_2$	Lbs. 50 per cent $ZnCl_2$ in 1 cu. ft.
0	1.0000	0	62.37	0	0	0
1	1.0069	.76	62.80	.4773	1.52	.9546
2	1.0140	1.53	63.24	.9676	3.06	1.9352
3	1.0211	2.29	63.69	1.4585	4.58	2.9170
4	1.0284	3.05	64.14	1.9563	6.10	3.9126
5	1.0357	3.81	64.60	2.4613	7.62	4.9226
6	1.0432	4.63	65.06	3.0123	9.26	6.0246
7	1.0507	5.45	65.53	3.5714	10.90	7.1428
8	1.0584	6.27	66.01	4.1388	12.54	8.2776
9	1.0662	7.09	66.50	4.7149	14.18	9.4298
10	1.0741	7.91	66.99	5.2980	15.82	10.5978
11	1.0821	8.78	67.49	5.9256	17.56	11.8512
12	1.0902	9.65	68.00	6.5620	19.30	13.1240
13	1.0985	10.52	68.51	7.2073	21.04	14.4146
14	1.1069	11.39	69.04	7.8637	22.78	15.7274
15	1.1154	12.26	69.57	8.5293	24.52	17.0586
16	1.1240	13.21	70.10	9.2602	26.42	18.5204
17	1.1328	14.15	70.65	9.9970	28.30	19.9940
18	1.1417	15.10	71.21	10.7527	30.20	21.5054
19	1.1508	16.04	71.78	11.5135	32.08	23.0270
20	1.1600	16.98	72.35	12.2850	33.96	24.5700
21	1.1694	17.96	72.94	13.1000	35.92	26.2000
22	1.1789	18.94	73.53	13.9266	37.88	27.8532
23	1.1885	19.92	74.13	14.7667	39.84	29.5334
24	1.1983	20.90	74.74	15.6207	41.80	31.2414
25	1.2083	21.88	75.36	16.4888	43.76	32.9776
26	1.2185	22.88	76.00	17.3888	45.76	34.7776
27	1.2288	23.88	76.64	18.3016	47.76	36.6032
28	1.2393	24.89	77.30	19.2400	49.78	38.4800
29	1.2500	25.89	77.96	20.1838	51.78	40.3676
30	1.2609	26.90	78.64	21.1542	53.80	42.3084
31	1.2719	27.91	79.33	22.1410	55.82	44.2820
32	1.2832	28.91	80.03	23.1367	57.82	46.2734
33	1.2946	29.92	80.74	24.1574	59.84	48.3148
34	1.3063	30.93	81.47	25.1987	61.86	50.3974
35	1.3182	31.93	82.22	26.2528	63.86	52.5056
36	1.3303	32.94	82.97	27.3303	65.88	54.6606
37	1.3426	33.95	83.74	28.4297	67.90	56.8594
38	1.3551	34.96	84.52	29.5482	69.92	59.0964
39	1.3679	35.97	85.32	30.6896	71.94	61.3792
40	1.3810	36.98	86.13	31.8509	73.96	63.7018
41	1.3942	38.02	86.96	33.0622	76.04	66.1244
42	1.4078	39.05	87.80	34.2859	78.10	68.5718
43	1.4216	40.09	88.67	35.5478	80.18	71.0956
44	1.4356	41.12	89.54	36.8188	82.24	73.6376
45	1.4500	42.16	90.44	38.1295	84.32	76.2590
46	1.4646	43.21	91.35	39.4723	86.42	78.9446
47	1.4796	44.26	92.28	40.8431	88.52	81.6862
48	1.4948	45.32	93.23	42.2518	90.64	84.5036
49	1.5104	46.37	94.20	43.6805	92.74	87.3610
50	1.5263	47.43	95.20	45.1534	94.86	90.3068
51	1.5426	48.48	96.21	46.6426	96.96	93.2852
52	1.5591	49.54	97.24	48.1727	99.08	96.3454

ZINC CHLORIDE (Continued)

Specific Gravity of Aqueous Zinc Chloride Solutions at $\frac{60°}{60°}$ F. (Whitney, Hartle, Sakryd)

Bé.	Sp. gr.	Per cent $ZnCl_2$	Weight of 1 cu. ft. in lbs.	Lbs. $ZnCl_2$ in 1 cu. ft.	Per cent 50 per cent $ZnCl_2$	Lbs. 50 per cent $ZnCl_2$ in 1 cu. ft.
53	1.5761	50.60	98.30	49.7398	101.20	99.4796
54	1.5934	51.66	99.38	51.3397	103.32	102.6794
55	1.6111	52.72	100.48	52.9731	105.44	105.9462
56	1.6292	53.80	101.61	54.6662	107.60	109.3324
57	1.6477	54.88	102.77	56.4002	109.76	112.8004
58	1.6667	55.97	103.95	58.1808	111.94	116.3616
59	1.6860	57.06	105.16	60.0043	114.12	120.0086
60	1.7059	58.15	106.40	61.8716	116.30	123.7432
61	1.7262	59.23	107.66	63.7670	118.46	127.5340
62	1.7470	60.30	108.96	65.7029	120.60	131.4058
63	1.7683	61.37	110.29	67.6850	122.74	135.3700
64	1.7901	62.44	111.65	69.7143	124.88	139.4286
65	1.8125	63.52	113.05	71.8094	127.04	143.6188
66	1.8354	64.68	114.47	74.0392	129.36	148.0784
67	1.8590	65.85	115.95	76.3531	131.70	152.7062
68	1.8831	67.02	117.45	78.7150	134.04	157.4300
69	1.9079	68.19	119.90	81.1461	136.38	162.2922
70	1.9333	69.36	120.58	83.6343	138.72	167.2696

FIXED POINTS*

Bé.	Sp. gr.	Per cent $ZnCl_2$
5.08	1.0363	3.88
10.16	1.0754	8.05
15.35	1.1184	12.59
20.35	1.1633	17.32
25.14	1.1707	22.02
30.00	1.2609	26.90
35.07	1.3190	32.00
40.15	1.3829	37.14
44.99	1.4499	42.15
50.14	1.5285	47.58
55.05	1.6120	52.77
60.13	1.7085	58.29
65.11	1.8150	63.65
70.05	1.9345	69.42

APPROXIMATE ALLOWANCE FOR TEMPERATURE

For each 1° Fahrenheit

At 5° Bé.	= 0.024° Bé.
" 10° "	= 0.029° "
" 15° "	= 0.029° "
" 20° "	= 0.033° "
" 25° "	= 0.033° "
" 30° "	= 0.033° "
" 35° "	= 0.033° "
" 40° "	= 0.033° "
" 45° "	= 0.033° "
" 50° "	= 0.030° "
" 55° "	= 0.028° "
" 60° "	= 0.027° "
" 65° "	= 0.027° "
" 70° "	= 0.024° "

*The percentage composition on all fixed points were determined b actual chemical analysis, both Zinc and Chlorine being determined.

ZINC NITRATE

SPECIFIC GRAVITY OF AQUEOUS ZINC NITRATE SOLUTIONS AT $\frac{18^\circ}{4^\circ}$ C.*

Bé.	Sp. gr.	Per cent $Zn(NO_3)_2$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
2.2	1.0154	2	20.31	1.268	0.1695
4.5	1.0322	4	41.29	2.577	0.3446
6.9	1.0496	6	62.98	3.931	0.5256
9.2	1.0675	8	85.40	5.331	0.7127
11.5	1.0859	10	108.6	6.779	0.9062
13.8	1.1048	12	132.6	8.276	1.106
16.0	1.1244	14	157.4	9.827	1.314
18.3	1.1445	16	183.1	11.43	1.528
20.6	1.1652	18	209.7	13.09	1.750
22.8	1.1865	20	237.3	14.81	1.980
28.3	1.2427	25	310.7	19.39	2.593
33.7	1.3029	30	390.9	24.40	3.262
39.0	1.3678	35	478.7	29.89	3.995
44.2	1.4378	40	575.1	35.90	4.799
49.2	1.5134	45	681.0	42.51	5.683
54.1	1.5944	50	797.2	49.77	6.653

ZINC NITRATE

Specific Gravity of Aqueous Zinc Nitrate Solutions at 17.5° (Franz)

Bé.	Sp. gr.	Per cent $Zn(NO_3)_2$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.4	1.0099	1	10.10	0.6305	0.0843
2.8	1.0198	2	20.40	1.273	0.1702
4.2	1.0297	3	30.89	1.928	0.2578
5.5	1.0396	4	41.58	2.596	0.3470
6.9	1.0496	5	52.48	3.276	0.4380
8.1	1.0590	6	63.54	3.967	0.5303
9.3	1.0684	7	74.79	4.669	0.6241
10.5	1.0778	8	86.22	5.383	0.7196
11.6	1.0872	9	97.85	6.108	0.8166
12.8	1.0968	10	109.7	6.847	0.9153
14.0	1.1070	11	121.8	7.602	1.016
15.2	1.1172	12	134.1	8.369	1.119
16.4	1.1274	13	146.6	9.149	1.223
17.5	1.1376	14	159.3	9.942	1.329
18.6	1.1476	15	172.1	10.75	1.437
19.9	1.1586	16	185.4	11.57	1.547
21.0	1.1696	17	198.8	12.41	1.659
22.2	1.1806	18	212.5	13.27	1.773
23.3	1.1916	19	226.4	14.13	1.889
24.4	1.2024	20	240.5	15.01	2.007
25.6	1.2147	21	255.1	15.92	2.129
26.8	1.2270	22	269.9	16.85	2.253
28.0	1.2393	23	285.0	17.79	2.379
29.1	1.2516	24	300.4	18.75	2.507
30.3	1.2640	25	316.0	19.73	2.637
31.4	1.2766	26	331.9	20.72	2.770
32.5	1.2892	27	348.1	21.73	2.905
33.6	1.3018	28	364.5	22.75	3.042
34.7	1.3144	29	381.2	23.80	3.181
35.7	1.3268	30	398.0	24.85	3.322
36.8	1.3396	31	415.3	25.92	3.466
37.8	1.3524	32	432.8	27.02	3.612
38.8	1.3652	33	450.5	28.12	3.760
39.8	1.3780	34	468.5	29.25	3.910
40.7	1.3906	35	486.7	30.38	4.062
41.7	1.4039	36	505.4	31.55	4.218
42.7	1.4172	37	524.4	32.73	4.376
43.6	1.4305	38	543.6	33.93	4.536
44.6	1.4438	39	563.1	35.15	4.699
45.5	1.4572	40	582.9	36.39	4.864
46.4	1.4707	41	603.0	37.64	5.032
47.3	1.4844	42	623.4	38.92	5.203
48.2	1.4981	43	644.2	40.21	5.376
49.1	1.5118	44	665.2	41.53	5.551
50.0	1.5258	45	686.6	42.86	5.730
50.9	1.5403	46	708.5	44.23	5.913
51.7	1.5548	47	730.8	45.62	6.098
52.6	1.5693	48	753.3	47.02	6.286
53.4	1.5838	49	776.1	48.45	6.476
54.3	1.5984	50	799.2	49.89	6.669

ZINC SULFATE

Specific Gravity of Aqueous Zinc Sulfate Solutions at $\frac{20°}{4°}$ C.*

Bé.	Sp. gr.	Per cent $ZnSO_4$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
2.7	1.0190	2	20.38	1.272	0.1701
5.6	1.0403	4	41.61	2.598	0.3473
8.5	1.0620	6	63.72	3.978	0.5318
11.3	1.0842	8	86.74	5.415	0.7238
14.0	1.1071	10	110.7	6.911	0.9239
16.8	1.1308	12	135.7	8.471	1.132
19.5	1.1553	14	161.7	10.10	1.350
22.2	1.1806	16	188.9	11.79	1.576

Bé.	Sp. gr.	Per cent $ZnSO_4 + 7H_2O$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
2.7	1.0190	3.562	36.30	2.266	0.3030
5.6	1.0403	7.125	74.12	4.627	0.6185
8.5	1.0620	10.69	113.5	7.085	0.9472
11.3	1.0842	14.25	154.5	9.645	1.289
14.0	1.1071	17.81	197.2	12.31	1.646
16.8	1.1308	21.37	241.7	15.09	2.017
19.5	1.1533	24.94	288.1	17.99	2.404
22.2	1.1806	28.50	336.5	21.00	2.808

ZINC SULFATE

Specific Gravity of Aqueous Zinc Sulfate Solutions at 15° C. (Gerlach)

Bé.	Sp. gr.	Per cent $ZnSO_4 + 7H_2O$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.9	1.006	1	10.06	0.6280	0.0840
1.9	1.013	2	20.26	1.265	0.1691
2.7	1.019	3	30.57	1.908	0.2551
3.4	1.024	4	40.96	2.557	0.3418
4.1	1.029	5	51.45	3.212	0.4294
4.9	1.035	6	62.10	3.877	0.5182
5.7	1.041	7	72.87	4.549	0.6081
6.5	1.047	8	83.76	5.229	0.6990
7.3	1.053	9	94.77	5.916	0.7909
8.1	1.059	10	105.9	6.611	0.8838
9.0	1.066	11	117.3	7.320	0.9786
9.9	1.073	12	128.8	8.038	1.075
10.6	1.079	13	140.3	8.757	1.171
11.4	1.085	14	151.9	9.483	1.268
12.1	1.091	15	163.7	10.22	1.366
12.8	1.097	16	175.5	10.96	1.465
13.5	1.103	17	187.5	11.71	1.565
14.4	1.110	18	199.8	12.47	1.667
15.1	1.116	19	212.0	13.24	1.770
16.0	1.124	20	224.8	14.03	1.876
16.7	1.130	21	237.3	14.81	1.980
17.5	1.137	22	250.1	15.62	2.087
18.1	1.143	23	262.9	16.41	2.194
18.9	1.150	24	276.0	17.23	2.303
19.7	1.157	25	289.3	18.06	2.414
20.4	1.164	26	302.6	18.89	2.526
21.2	1.171	27	316.2	19.74	2.639
22.0	1.179	28	330.1	20.61	2.755
22.6	1.185	29	343.7	21.45	2.868
23.5	1.193	30	357.9	22.34	2.987
24.2	1.200	31	372.0	23.22	3.104
25.1	1.209	32	386.9	24.15	3.229
25.8	1.216	33	401.3	25.05	3.349
26.5	1.224	34	416.2	25.98	3.473
27.2	1.231	35	430.9	26.90	3.560
28.1	1.240	36	446.4	27.87	3.725
28.6	1.246	37	461.0	28.78	3.847
29.5	1.255	38	476.9	29.77	3.980
30.2	1.263	39	492.6	30.75	4.111
30.9	1.271	40	508.4	31.74	4.243
31.7	1.280	41	524.8	32.76	4.380
32.4	1.288	42	540.0	33.77	4.514
33.0	1.295	43	556.9	34.76	4.647
33.8	1.304	44	573.8	35.82	4.788
34.3	1.310	45	589.5	36.80	4.920
35.2	1.320	46	607.2	37.91	5.067
36.0	1.330	47	625.1	39.02	5.217
36.6	1.337	48	641.8	40.06	5.356
37.3	1.346	49	659.5	41.17	5.504
37.8	1.353	50	676.5	42.23	5.646
38.5	1.362	51	694.6	43.36	5.797
39.2	1.370	52	712.4	44.47	5.945
39.9	1.380	53	731.4	45.66	6.104
40.7	1.390	54	750.6	46.86	6.264
41.4	1.399	55	769.5	48.03	6.421
41.9	1.406	56	787.4	49.15	6.571
42.6	1.416	57	807.1	50.39	6.736
43.2	1.425	58	826.5	51.60	6.897
44.0	1.435	59	846.7	52.85	7.065
44.7	1.445	60	867.0	54.12	7.235

ZINC SULFATE (Continued)

Specific Gravity of Aqueous Zinc Sulfate Solutions at 15° C. (Gerlach)

Bé.	Sp. gr.	Per cent $ZnSO_4$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.9	1.006	0.56	5.648	0.3526	0.0471
1.9	1.013	1.12	11.37	0.7101	0.0949
2.7	1.019	1.68	17.16	1.071	0.1432
3.4	1.024	2.25	23.00	1.436	0.1919
4.1	1.029	2.81	28.89	1.803	0.2411
4.9	1.035	3.37	34.86	2.177	0.2910
5.7	1.041	3.93	40.91	2.554	0.3414
6.5	1.047	4.49	47.03	2.936	0.3924
7.3	1.053	5.05	53.21	3.322	0.4440
8.1	1.059	5.61	59.46	3.712	0.4962
9.0	1.066	6.18	65.83	4.110	0.5494
9.9	1.073	6.74	72.29	4.513	0.6033
10.6	1.079	7.30	78.75	4.916	0.6572
11.4	1.085	7.86	85.28	5.324	0.7117
12.0	1.091	8.42	91.88	5.736	0.7667
12.8	1.097	8.98	98.54	6.152	0.8224
13.5	1.103	9.54	105.3	6.572	0.8786
14.4	1.110	10.1	112.2	7.003	0.9361
15.1	1.116	10.7	119.0	7.432	0.9935
16.0	1.124	11.2	126.2	7.879	1.053
16.7	1.130	11.8	133.2	8.317	1.112
17.5	1.137	12.4	140.4	8.767	1.172
18.1	1.143	12.9	147.6	9.214	1.232
18.9	1.150	13.5	155.0	9.673	1.293
19.7	1.157	14.0	162.4	10.14	1.355
20.4	1.164	14.6	169.9	10.61	1.418
21.2	1.171	15.2	177.5	11.08	1.481
22.0	1.179	15.7	185.3	11.57	1.547
22.6	1.185	16.3	192.9	12.04	1.610
23.5	1.193	16.8	200.9	12.54	1.677
24.2	1.200	17.4	208.9	13.04	1.743
25.1	1.209	18.0	217.2	13.56	1.813
25.8	1.216	18.5	225.3	14.06	1.880
26.5	1.224	19.1	233.6	14.59	1.950
27.2	1.231	19.7	241.9	15.10	2.019
28.1	1.240	20.2	250.6	15.65	2.092
28.6	1.246	20.8	258.8	16.16	2.160
29.5	1.255	21.3	267.7	16.71	2.234
30.2	1.263	21.9	276.5	17.26	2.308
30.9	1.271	22.5	285.4	17.82	2.382
31.7	1.280	23.0	294.6	18.39	2.459
32.4	1.288	23.6	303.7	18.96	2.535
33.0	1.295	24.1	312.6	19.52	2.609
33.8	1.304	24.7	322.1	20.11	2.688
34.3	1.310	25.3	331.0	20.66	2.762
35.2	1.320	25.8	340.9	21.28	2.845
36.0	1.330	26.4	350.9	21.91	2.929
36.6	1.337	26.9	360.3	22.49	3.007
37.3	1.346	27.5	370.3	23.12	3.090
37.8	1.353	28.1	379.8	23.71	3.170
38.5	1.362	28.6	390.0	24.35	3.254
39.2	1.370	29.2	400.0	24.97	3.338
39.9	1.380	29.8	410.6	25.63	3.427
40.7	1.390	30.3	421.4	26.31	3.517
41.4	1.399	30.9	432.0	26.97	3.605
41.9	1.406	31.4	442.0	27.60	3.689
42.6	1.416	32.0	453.1	28.29	3.782
43.2	1.425	32.6	464.0	28.97	3.872
44.0	1.435	33.1	475.3	29.67	3.967
44.7	1.445	33.7	486.8	30.39	4.062

SPECIFIC GRAVITY OF AQUEOUS SOLUTIONS

THE SPECIFIC GRAVITY OF AQUEOUS SOLUTIONS EXPRESSED IN GRAMS O
THE SUBSTANCE SHOWN BY THE FORMULA PER 100 GRAMS
OF THE AQUEOUS SOLUTION

Per cent by weight	$AgNO_3$ $\frac{20°}{4°}$ C.	$Al(NO_3)_3$ $\frac{18°}{4°}$ C.	$AuCl_3$ $\frac{15°}{4°}$ C.	$Ba(C_2H_3O_2)_2$ $\frac{18°}{4°}$ C.	$BaBr_2$ $\frac{20°}{4°}$ C.
1	1.0070	1.0065	1.0060	1.0059	.....
2	1.0154	1.0144	1.0132	1.0133	1.0156
3	.....	.....	.....	.....	.....
4	1.0327	1.0305	1.0281	1.0282	1.0335
5	.....	.....	.....	.....	.....
6	1.0506	1.0469	1.0434	1.0433	1.0519
7	.....	.....	.....	.....	.....
8	1.0690	1.0638	1.0591	1.0587	1.0710
9	.....	.....	.....	.....	.....
10	1.0882	1.0811	1.0750	1.0745	1.0907
11	.....	.....	.....	.....	.....
12	1.1080	1.0989	.....	1.0908	1.1111
13	.....	.....	.....	.....	.....
14	1.1284	1.1171	.....	1.1075	1.1323
15	.....	.....	.....	.....	.....
16	1.1495	1.1357	.....	1.1246	1.1543
17	.....	.....	.....	.....	.....
18	1.1715	1.1549	.....	1.1421	1.1770
19	.....	.....	.....	.....	.....
20	1.1942	1.1745	.....	1.1599	1.2006
21	.....	.....	.....	.....	.....
22	.....	1.1946	.....	1.1782	.....
23	.....	.....	.....	.....	.....
24	.....	1.2153	.....	1.1970	.....
25	1.2545	.....	.....	.....	1.2634
26	.....	1.2365	.....	1.2161	.....
27	.....	.....	.....	.....	.....
28	.....	1.2582	.....	1.2356	.....
29	.....	.....	.....	.....	.....
30	1.3205	1.2805	.....	1.2554	1.3325
31	.....	.....	.....	.....	.....
32	.....	1.3036	.....	.....	.....
33	.....	.....	.....	.....	.....
34	.....	.....	.....	.....	.....
35	1.3931	.....	.....	1.3069	1.4087
36	.....	.....	.....	.....	.....
37	.....	.....	.....	.....	.....
38	.....	.....	.....	.....	.....
39	.....	.....	.....	.....	.....
40	1.4743	.....	.....	1.3608	1.4926
42	.....	.....	.....	.....	.....
44	.....	.....	.....	.....	.....
45	1.565	.....	.....	.....	.....
46	.....	.....	.....	.....	.....
48	.....	.....	.....	.....	.....
50	1.668	.....	.....	.....	.....
55	1.786	.....	.....	.....	.....
60	1.916	.....	.....	.....	.....
65	.....	.....	.....	.....	.....
70	2.2333	.....	.....	.....	.....
75	.....	.....	.....	.....	.....
80	.....	.....	.....	.....	.....

SPECIFIC GRAVITY OF AQUEOUS SOLUTIONS
(Continued)

Per cent by weight	BaI_2 $\frac{20°}{4°}$ C.	$Ba(NO_3)_2$ $\frac{18°}{4°}$ C.	$C_{12}H_{22}O_{11}$ Sucrose $\frac{20°}{4°}$ C.	$CaBr_2$ $\frac{20°}{4°}$ C.	$Ca(C_2H_3O_2)_2$ $\frac{18°}{4°}$ C.
1	.....	.....	1.0021	.....	1.0043
2	1.0154	1.0151	1.0060	1.0152	1.0100
3	.....	.....	1.0099	.....	.....
4	1.0331	1.0320	1.0139	1.0326	1.0215
5	.....	.....	1.0179	.....	.....
6	1.0513	1.0494	1.0219	1.0504	1.0331
7	.....	.....	1.0259	.....	.....
8	1.0701	1.0674	1.0299	1.0688	1.0447
9	.....	.....	1.0340	.....	.....
10	1.0896	.....	1.0381	1.0877	1.0563
11	.....	.....	1.0423	.....	.....
12	1.1099	.....	1.0465	1.1071	1.0679
13	.....	.....	1.0507	.....	.....
14	1.1308	.....	1.0549	1.1272	1.0795
15	.....	.....	1.0592	.....	.....
16	1.1525	.....	1.0635	1.1480	1.0912
17	.....	.....	1.0678	.....	.....
18	1.1750	.....	1.0722	1.1696	1.1029
19	.....	.....	1.0765	.....	.....
20	1.1984	.....	1.0810	1.1919	1.1146
21	.....	.....	1.0854	.....	.....
22	.....	.....	1.0899	.....	1.1263
23	.....	.....	1.0944	.....	.....
24	.....	.....	1.0990	.....	.....
25	1.2610	.....	1.1036	1.2499	.....
26	.....	.....	1.1082	.....	.....
27	.....	.....	1.1128	.....	.....
28	.....	.....	1.1175	.....	.....
29	.....	.....	1.1222	.....	.....
30	1.3289	.....	1.1270	1.3125	.....
31	.....	.....	1.1377	.....	.....
32	.....	.....	1.1366	.....	.....
33	.....	.....	1.1415	.....	.....
34	.....	.....	1.1464	.....	.....
35	1.404	.....	1.1513	1.381	.....
36	.....	.....	1.1563	.....	.....
37	.....	.....	1.1612	.....	.....
38	.....	.....	1.1663	.....	.....
39	.....	.....	1.1713	.....	.....
40	1.490	.....	1.1765	1.457	.....
42	.....	.....	1.1868	.....	.....
44	.....	.....	1.1973	.....	.....
45	1.587	.....	1.2025	1.541	.....
46	.....	.....	1.2079	.....	.....
48	.....	.....	1.2186	.....	.....
50	1.698	.....	1.2296	1.635	.....
55	1.825	.....	1.2575	.....	.....
60	1.970	.....	1.2865	.....	.....
65	.....	.....	1.3163	.....	.....
70	.....	.....	1.3472	.....	.....
75	.....	.....	1.3790	.....	.....
80	.....	.....	1.4117	.....	.....

SPECIFIC GRAVITY OF AQUEOUS SOLUTIONS
(Continued)

Per cent by weight	CaI_2 $\frac{20°}{4°}$ C	$Ca(NO_3)$ $\frac{18°}{4°}$ C	$CdBr_2$ $\frac{20°}{4°}$ C	$CdCl_2$ $\frac{20°}{4°}$ C	CdI_2 $\frac{20°}{4°}$ C
1	.....	.....	.....	.....	.....
2	1.0150	1.0137	1.0158	1.0159	1.0153
3	.....	.....	.....	.....	.....
4	1.0323	1.0291	1.0339	1.0339	1.0328
5	.....	.....	.....	.....	.....
6	1.0500	1.0448	1.0524	1.0524	1.0507
7	.....	.....	.....	.....	.....
8	1.0683	1.0608	1.0714	1.0715	1.0690
9	.....	.....	.....	.....	.....
10	1.0873	1.0771	1.0910	1.0912	1.0879
11	.....	.....	.....	.....	.....
12	1.1069	1.0937	1.1112	1.1115	1.1075
13	.....	.....	.....	.....	.....
14	1.1273	1.1106	1.1322	1.1324	1.1278
15	.....	.....	.....	.....	.....
16	1.1485	1.1279	1.1540	1.1540	1.1489
17	.....	.....	.....	.....	.....
18	1.1703	1.1455	1.1766	1.1762	1.1709
19	.....	.....	.....	.....	.....
20	1.1928	1.1636	1.2000	1.1992	1.1937
21	.....	.....	.....	.....	.....
22	.....	.....	.....	.....	.....
23	.....	.....	.....	.....	.....
24	.....	.....	.....	.....	.....
25	1.2530	1.2106	1.2605	1.2604	1.2546
26	.....	.....	.....	.....	.....
27	.....	.....	.....	.....	.....
28	.....	.....	.....	.....	.....
29	.....	.....	.....	.....	.....
30	1.3195	1.260	1.3286	1.3273	1.3219
31	.....	.....	.....	.....	.....
32	.....	.....	.....	.....	.....
33	.....	.....	.....	.....	.....
34	.....	.....	.....	.....	.....
35	1.3928	1.311	1.4049	1.4010	1.3967
36	.....	.....	.....	.....	.....
37	.....	.....	.....	.....	.....
38	.....	.....	.....	.....	.....
39	.....	.....	.....	.....	.....
40	1.4734	1.365	1.4902	1.4833	1.4801
42	.....	.....	.....	.....	.....
44	.....	.....	.....	.....	.....
45	.....	1.422	.....	1.5748	1.5726
46	.....	.....	.....	.....	.....
48	.....	.....	.....	.....	.....
50	.....	.....	.....	1.6762	.....
55	.....	.....	.....	.....	.....
60	.....	.....	.....	.....	.....
65	.....	.....	.....	.....	.....
70	.....	.....	.....	.....	.....
75	.....	.....	.....	.....	.....
80	.....	.....	.....	.....	.....

SPECIFIC GRAVITY OF AQUEOUS SOLUTIONS
(Continued)

Per cent by weight	$CdSO_4$ $\frac{18°\ C.}{4°}$	$CoCl_2$ $\frac{20°\ C.}{4°}$	$Co(NO_3)_2$ $\frac{20°\ C.}{4°}$	HBr $\frac{20°\ C.}{4°}$	$HClO_4$ $\frac{15°\ C.}{4°}$
1	1.0086	1.0073	1.0064	1.0053	1.0050
2	1.0182	1.0165	1.0145	1.0124	1.0109
3	.....	.....	.....	.....	.....
4	1.0383	1.0350	1.0315	1.0269	1.0228
5	.....	.....	.....	.....	.....
6	1.0590	1.0538	1.0485	1.0417	1.0348
7	.....	.....	.....	.....	.....
8	1.0803	1.0735	1.0660	1.0568	1.0471
9	.....	.....	.....	.....	.....
10	1.1023	1.0940	1.084	1.0723	1.0597
11	.....	.....	.....	.....	.....
12	1.1250	1.1150	1.103	1.0883	1.0726
13	.....	.....	.....	.....	.....
14	1.1485	1.1365	1.122	1.1048	1.0859
15	.....	.....	.....	.....	.....
16	1.1729	1.1585	1.142	1.1219	1.0995
17	.....	.....	.....	.....	.....
18	1.1982	1.1815	1.163	1.1396	1.1135
19	.....	.....	.....	.....	.....
20	1.2243	1.2050	1.184	1.1579	1.1279
21	.....	.....	.....	.....	.....
22	.....	.....	.....	1.1767	1.1428
23	.....	.....	.....	.....	.....
24	.....	.....	.....	1.1961	1.1581
25	1.2940	.....	1.239	.....	.....
26	.....	.....	.....	1.2161	1.1738
27	.....	.....	.....	.....	.....
28	.....	.....	.....	1.2367	1.1900
29	.....	.....	.....	.....	.....
30	1.3714	.....	1.299	1.2580	1.2067
31	.....	.....	.....	.....	.....
32	.....	.....	.....	.....	1.2239
33	.....	.....	.....	.....	.....
34	.....	.....	.....	.....	1.2418
35	1.4551	.....	.....	1.3150	.....
36	.....	.....	.....	.....	1.2603
37	.....	.....	.....	.....	.....
38	.....	.....	.....	.....	1.2794
39	.....	.....	.....	.....	.....
40	1.5470	.....	.....	1.3772	1.2991
42	.....	.....	.....	.....	.....
44	.....	.....	.....	.....	.....
45	.....	.....	.....	1.4446	1.3521
46	.....	.....	.....	.....	.....
48	.....	.....	.....	.....	.....
50	.....	.....	.....	1.5173	1.4103
55	.....	.....	.....	1.5953	1.4733
60	.....	.....	.....	1.6787	1.5389
65	.....	.....	.....	1.7675	1.6059
70	.....	.....	.....	.....	1.6736
75	.....	.....	.....	.....	.....
80	.....	.....	.....	.....	.....

SPECIFIC GRAVITY OF AQUEOUS SOLUTIONS
(Continued)

Per cent by weight	HF $\frac{20°\ C.}{4°}$	HI $\frac{20°\ C.}{4°}$	HIO_3 $\frac{18°\ C.}{4°}$	HIO_4 $\frac{17°\ C.}{4°}$	H_2O_2 $\frac{18°\ C.}{4°}$
1	.....	1.0054	1.0071	1.0076	1.0022
2	.....	1.0127	1.0157	1.0165	1.0058
3	.....	.....	.....	.....	.....
4	.....	1.0277	1.0334	1.0349	1.0131
5	1.017	.....	.....	.....	.....
6	.....	1.0431	1.0517	1.0539	1.0204
7	.....	.....	.....	.....	.....
8	.....	1.0589	1.0706	1.0737	1.0277
9	.....	.....	.....	.....	.....
10	1.035	1.0751	1.0900	1.0944	1.0351
11	.....	.....	.....	.....	.....
12	.....	1.0918	1.1100	1.1161	1.0425
13	.....	.....	.....	.....	.....
14	.....	1.1091	1.1306	1.1388	1.0499
15	1.053	.....	.....	.....	.....
16	.....	1.1270	1.1519	1.1623	1.0574
17	.....	.....	.....	.....	.....
18	.....	1.1456	1.1740	1.1865	1.0649
19	.....	.....	.....	.....	.....
20	1.070	1.1649	1.1969	1.2116	1.0725
21	.....	.....	.....	.....	.....
22	.....	1.1850	1.2206	1.2376	1.0802
23	.....	.....	.....	.....	.....
24	.....	1.2059	1.2450	1.2647	1.0880
25	1.086	.....	.....	.....	.....
26	.....	1.2277	1.2700	1.2931	1.0959
27	.....	.....	.....	.....	.....
28	.....	1.2503	1.2956	1.3230	1.1040
29	.....	.....	.....	.....	.....
30	1.101	1.2737	1.3218	1.3545	1.1122
31	.....	.....	.....	.....	.....
32	.....	.....	.....	1.3875	.....
33	.....	.....	.....	.....	.....
34	.....	.....	.....	.....	.....
35	1.116	1.3357	1.3900	.....	1.1327
36	.....	.....	.....	.....	.....
37	.....	.....	.....	.....	.....
38	.....	.....	.....	.....	.....
39	.....	.....	.....	.....	.....
40	1.130	1.4029	1.4640	.....	1.1536
42	.....	.....	.....	.....	.....
44	.....	.....	.....	.....	.....
45	1.143	1.4755	.....	.....	1.1749
46	.....	.....	.....	.....	.....
48	.....	.....	.....	.....	.....
50	1.155	.....	.....	.....	1.1966
55	.....	.....	.....	.....	1.2188
60	.....	.....	.....	.....	1.2416
65	.....	.....	.....	.....	1.2652
70	.....	.....	.....	.....	1.2897
75	.....	.....	.....	.....	1.3149
80	.....	.....	.....	.....	1.3406

SPECIFIC GRAVITY OF AQUEOUS SOLUTIONS
(Continued)

Per cent by weight	H_2SeO_4 $\frac{20°}{4°}$ C.	$HgCl_2$ $\frac{20°}{4°}$ C.	$KC_2H_3O_2$ $\frac{18°}{4°}$ C.	$KBrO_3$ $\frac{20°}{4°}$ C.	$KClO_3$ $\frac{20°}{4°}$ C.
1	1.0059	1.0065	1.0038	1.0056	1.0045
2	1.0136	1.0150	1.0089	1.0131	1.0109
3	.....	1.0236	.....	1.0206	1.0174
4	1.0291	1.0323	1.0191	1.0282	1.0241
5	.....	1.0411	.....	1.0359	.....
6	1.0447	.....	1.0293	.....	.....
7	.....	.....	.....	.....	.....
8	1.0605	.....	1.0395	.....	.....
9	.....	.....	.....	.....	.....
10	1.0766	.....	1.0497	.....	.....
11	.....	.....	.....	.....	.....
12	1.0931	.....	1.0599	.....	.....
13	.....	.....	.....	.....	.....
14	1.1101	.....	1.0703	.....	.....
15	.....	.....	.....	.....	.....
16	1.1276	.....	1.0808	.....	.....
17	.....	.....	.....	.....	.....
18	1.1455	.....	1.0914	.....	.....
19	.....	.....	.....	.....	.....
20	1.1639	.....	1.1022	.....	.....
21	.....	.....	.....	.....	.....
22	1.1829	.....	1.1131	.....	.....
23	.....	.....	.....	.....	.....
24	1.2026	.....	1.1241	.....	.....
25	.....	.....	.....	.....	.....
26	1.2229	.....	1.1353	.....	.....
27	.....	.....	.....	.....	.....
28	1.2438	.....	1.1466	.....	.....
29	.....	.....	.....	.....	.....
30	1.2653	.....	1.1579	.....	.....
31	.....	.....	.....	.....	.....
32	1.2874	.....	.....	.....	.....
33	.....	.....	.....	.....	.....
34	1.3101	.....	.....	.....	.....
35	.....	.....	1.1868	.....	.....
36	1.3334	.....	.....	.....	.....
37	.....	.....	.....	.....	.....
38	1.3573	.....	.....	.....	.....
39	.....	.....	.....	.....	.....
40	1.3819	.....	1.2162	.....	.....
42	.....	.....	.....	.....	.....
44	1.4073	.....	.....	.....	.....
45	1.4336	.....	1.2460	.....	.....
46	1.4609	.....	.....	.....	.....
48	1.4892	.....	.....	.....	.....
50	1.5186	.....	1.2761	.....	.....
55	.....	.....	1.3065	.....	.....
60	1.6850	.....	1.3372	.....	.....
65	.....	.....	.....	.....	.....
70	1.8870	.....	.....	.....	.....
75	.....	.....	.....	.....	.....
80	2.1220	.....	.....	.....	.....

SPECIFIC GRAVITY OF AQUEOUS SOLUTIONS
(Continued)

Per cent by weight	KF $\frac{18^\circ}{4^\circ}$ C.	$KHSO_4$ $\frac{20^\circ}{4^\circ}$ C.	$K_4Fe(CN)_6$ $\frac{20^\circ}{4^\circ}$ C.	$K_3Fe(CN)_6$ $\frac{20^\circ}{4^\circ}$ C.	KIO_3 $\frac{20^\circ}{4^\circ}$ C.
1	1.0072	1.0051	1.0034	1.0051	1.0068
2	1.0159	1.0120	1.0090	1.0119	1.0155
3	.....	.....	.....	.....	1.0243
4	1.0334	1.0260	1.0201	1.0256	.....
5	.....	.....	.....	.....	.....
6	1.0512	1.0403	1.0314	1.0395	.....
7	.....	.....	.....	.....	.....
8	1.0693	1.0549	1.0427	1.0536	.....
9	.....	.....	.....	.....	.....
10	1.0877	1.0698	1.0542	1.0678	.....
11	.....	.....	.....	.....	.....
12	1.1064	1.0850	1.0656	1.0823	.....
13	.....	.....	.....	.....	.....
14	1.1254	1.1004	1.0774	1.0971	.....
15	.....	.....	.....	.....	.....
16	1.1448	1.1161	1.0890	1.1120	.....
17	.....	.....	.....	.....	.....
18	1.1646	.....	1.1010	.....	.....
19	.....	.....	.....	.....	.....
20	1.1847	.....	1.1130	.....	.....
21	.....	.....	.....	.....	.....
22	1.2052	.....	.....	.....	.....
23	.....	.....	.....	.....	.....
24	1.2260	.....	.....	.....	.....
25	.....	.....	.....	.....	.....
26	1.2471	.....	.....	.....	.....
27	.....	.....	.....	.....	.....
28	.....	.....	.....	.....	.....
29	.....	.....	.....	.....	.....
30	.....	.....	.....	.....	.....
31	.....	.....	.....	.....	.....
32	.....	.....	.....	.....	.....
33	.....	.....	.....	.....	.....
34	.....	.....	.....	.....	.....
35	.....	.....	.....	.....	.....
36	.....	.....	.....	.....	.....
37	.....	.....	.....	.....	.....
38	.....	.....	.....	.....	.....
39	.....	.....	.....	.....	.....
40	.....	.....	.....	.....	.....
42	.....	.....	.....	.....	.....
44	.....	.....	.....	.....	.....
45	.....	.....	.....	.....	.....
46	.....	.....	.....	.....	.....
48	.....	.....	.....	.....	.....
50	.....	.....	.....	.....	.....
55	.....	.....	.....	.....	.....
60	.....	.....	.....	.....	.....
65	.....	.....	.....	.....	.....
70	.....	.....	.....	.....	.....
75	.....	.....	.....	.....	.....
80	.....	.....	.....	.....	.....

SPECIFIC GRAVITY OF AQUEOUS SOLUTIONS
(Continued)

Per cent by weight	LiBr $\frac{20°}{4°}$ C.	LiCl $\frac{20°}{4°}$ C.	LiI $\frac{20°}{4°}$ C.	Li_2SO_4 $\frac{20°}{4°}$ C.	$MgBr_2$ $\frac{20°}{4°}$ C.
1	1.0055	1.0041	1.0056	1.0068	.....
2	1.0128	1.0099	1.0131	1.0155	1.0151
3	.....	.....	.....	.....	.....
4	1.0277	1.0215	1.0284	1.0329	1.0324
5	.....	.....	.....	.....	.....
6	1.0429	1.0330	1.0442	1.0505	1.0501
7	.....	.....	.....	.....	.....
8	1.0585	1.0444	1.0604	1.0684	1.0683
9	.....	.....	.....	.....	.....
10	1.0746	1.0559	1.0771	1.0863	1.0871
11	.....	.....	.....	.....	.....
12	1.0910	1.0675	1.0943	1.1044	1.1065
13	.....	.....	.....	.....	.....
14	1.1079	1.0792	1.1120	1.1228	1.1265
15	.....	.....	.....	.....	.....
16	1.1253	1.0910	1.1303	1.1411	1.1471
17	.....	.....	.....	.....	.....
18	1.1432	1.1029	1.1492	1.1599	1.1683
19	.....	.....	.....	.....	.....
20	1.1616	1.1150	1.1688	1.1789	1.1903
21	.....	.....	.....	.....	.....
22	1.1806	1.1274	1.1890	1.1984	.....
23	.....	.....	.....	.....	.....
24	1.2002	1.1399	1.2099	1.2182	.....
25	.....	.....	.....	.....	1.2482
26	1.2205	1.1527	1.2315	.....	.....
27	.....	.....	.....	.....	.....
28	1.2414	1.1658	1.2540	.....	.....
29	.....	.....	.....	.....	.....
30	1.2629	1.1791	1.2772	.....	1.3110
31	.....	.....	.....	.....	.....
32	.....	.....	.....	.....	.....
33	.....	.....	.....	.....	.....
34	.....	.....	.....	.....	.....
35	1.3204	.....	1.3393	.....	1.3790
36	.....	.....	.....	.....	.....
37	.....	.....	.....	.....	.....
38	.....	.....	.....	.....	.....
39	.....	.....	.....	.....	.....
40	1.3836	.....	1.4078	.....	1.452
42	.....	.....	.....	.....	.....
44	.....	.....	.....	.....	.....
45	1.4535	.....	1.4840	.....	1.5320
46	.....	.....	.....	.....	.....
48	.....	.....	.....	.....	.....
50	.....	.....	1.5692	.....	.....
55	.....	.....	1.6654	.....	.....
60	.....	.....	1.7748	.....	.....
65	.....	.....	.....	.....	.....
70	.....	.....	.....	.....	.....
75	.....	.....	.....	.....	.....
80	.....	.....	.....	.....	.....

SPECIFIC GRAVITY OF AQUEOUS SOLUTIONS
(Continued)

Per cent by weight	MgI_2 $\frac{20°}{4°}$ C.	$Mg(NO_3)_2$ $\frac{20°}{4°}$ C.	$MnBr_2$ $\frac{18°}{4°}$ C.	$MnCl_2$ $\frac{18°}{4°}$ C.
1	.....	.....	1.0071	1.0069
2	1.0149	1.0132	1.0157	1.0153
3	.....	.....	.....	.....
4	1.0321	1.0285	1.0332	1.0324
5	.....	.....	.....	.....
6	1.0498	1.0441	1.0511	1.0498
7	.....	.....	.....	.....
8	1.0680	1.0600	1.0695	1.0676
9	.....	.....	.....	.....
10	1.0869	1.0762	1.0886	1.0859
11	.....	.....	.....	.....
12	1.1065	1.0928	1.1083	1.1046
13	.....	.....	.....	.....
14	1.1268	1.1098	1.1287	1.1238
15	.....	.....	.....	.....
16	1.1478	1.1272	1.1498	1.1435
17	.....	.....	.....	.....
18	1.1695	1.1449	1.1716	1.1638
19	.....	.....	.....	.....
20	1.1920	1.1630	1.1942	1.1846
21	.....	.....	.....	.....
22	.....	1.1815	1.2176	1.2061
23	.....	.....	.....	.....
24	.....	1.2004	1.2419	1.2283
25	1.2519	.....	.....	.....
26	.....	.....	1.2672	1.2511
27	.....	.....	.....	.....
28	.....	.....	1.2934	1.2746
29	.....	.....	.....	.....
30	1.3180	.....	1.3206	1.2988
31	.....	.....	.....	.....
32	.....	.....	1.3489	.....
33	.....	.....	.....	.....
34	.....	.....	.....	.....
35	1.3914	.....	.....	.....
36	.....	.....	.....	.....
37	.....	.....	.....	.....
38	.....	.....	.....	.....
39	.....	.....	.....	.....
40	1.4730	.....	.....	.....
42	.....	.....	.....	.....
44	.....	.....	.....	.....
45	.....	.....	.....	.....
46	.....	.....	.....	.....
48	.....	.....	.....	.....
50	.....	.....	.....	.....
55	.....	.....	.....	.....
60	.....	.....	.....	.....
65	.....	.....	.....	.....
70	.....	.....	.....	.....
75	.....	.....	.....	.....
80	.....	.....	.....	.....

SPECIFIC GRAVITY OF AQUEOUS SOLUTIONS
(Continued)

Per cent by weight	$Mn(NO_3)_2$ $\frac{18°}{4°}$ C.	$MnSO_4$ $\frac{20°}{4°}$ C.	NH_4Br $\frac{25°}{4°}$ C.	$NH_4C_2H_3O_2$ $\frac{25°}{4°}$ C.
1	1.0063	1.0080	1.0027	0.9992
2	1.0140	1.0178	1.0084	1.0013
3	.....	.....	.....	.....
4	1.0298	1.0378	1.0198	1.0055
5	.....	.....	.....	.....
6	1.0459	1.0583	1.0314	1.0096
7	.....	.....	.....	.....
8	1.0624	1.0794	1.0432	1.0136
9	.....	.....	.....	.....
10	1.0794	1.1012	1.0552	1.0176
11	.....	.....	.....	.....
12	1.0969	1.1236	1.0674	1.0216
13	.....	.....	.....	.....
14	1.1149	1.1467	1.0799	1.0255
15	.....	.....	.....	.....
16	1.1333	1.1705	1.0927	1.0294
17	.....	.....	.....	.....
18	1.1522	1.1950	1.1058	1.0331
19	.....	.....	.....	.....
20	1.1717	.....	1.1191	1.0368
21	.....	.....	.....	.....
22	1.1918	.....	1.1327	1.0404
23	.....	.....	.....	.....
24	1.2125	.....	1.1466	1.0439
25	.....	.....	.....	.....
26	1.2338	.....	1.1608	1.0473
27	.....	.....	.....	.....
28	1.2557	.....	1.1753	1.0507
29	.....	.....	.....	.....
30	1.2781	.....	1.1901	1.0540
31	.....	.....	.....	.....
32	.....	.....	1.2053	.....
33	.....	.....	.....	.....
34	.....	.....	1.2209	.....
35	1.3367	.....	.....	1.0618
36	.....	.....	1.2369	.....
37	.....	.....	.....	.....
38	.....	.....	1.2533	.....
39	.....	.....	.....	.....
40	1.3993	.....	1.2702	1.0691
42	.....	.....	.....	.....
44	.....	.....	.....	.....
45	1.4662	.....	.....	1.0760
46	.....	.....	.....	.....
48	.....	.....	.....	.....
50	1.5378	.....	.....	.....
55	1.6146	.....	.....	.....
60	.....	.....	.....	.....
65	.....	.....	.....	.....
70	.....	.....	.....	.....
75	.....	.....	.....	.....
80	.....	.....	.....	.....

SPECIFIC GRAVITY OF AQUEOUS SOLUTIONS
(Continued)

Per cent by weight	NH_4I $\frac{18°}{4°}$ C.	N_2H_4 $\frac{15°}{4°}$ C.	NH_4OH $\frac{20°}{4°}$ C.	$NaBrO_3$ $\frac{18°}{4°}$ C.
1	1.0050	1.0002	1.0002	1.0064
2	1.0114	1.0013	1.0023	1.0143
3	.....	.....	.....	.....
4	1.0244	1.0034	1.0065	1.0305
5	.....	.....	.....	.....
6	1.0377	1.0056	1.0107	1.0471
7	.....	.....	.....	.....
8	1.0513	1.0077	1.0149	1.0641
9	.....	.....	.....	.....
10	1.0652	1.0099	1.0192	1.0816
11	.....	.....	.....	.....
12	1.0795	1.0121	1.0235	1.0996
13	.....	.....	.....	.....
14	1.0942	1.0143	1.0278	1.1182
15	.....	.....	.....	.....
16	1.1093	1.0164	1.0322	1.1373
17	.....	.....	.....	.....
18	1.1248	1.0186	1.0366	1.1569
19	.....	.....	.....	.....
20	1.1407	1.0207	1.0410	1.1771
21	.....	.....	.....	.....
22	1.1570	1.0228	1.0454	1.1979
23	.....	.....	.....	.....
24	1.1737	1.0248	1.0499	1.2193
25	.....	.....	.....	.....
26	1.1908	1.0267	1.0545	.....
27	.....	.....	.....	.....
28	1.2084	1.0286	1.0591	.....
29	.....	.....	.....	.....
30	1.2265	1.0305	1.0637	.....
31	.....	.....	.....	.....
32	.....	.....	.....	.....
33	.....	.....	.....	.....
34	.....	.....	.....	.....
35	1.2745	1.0350	1.0755	.....
36	.....	.....	.....	.....
37	.....	.....	.....	.....
38	.....	.....	.....	.....
39	.....	.....	.....	.....
40	1.3264	1.0380	1.0875	.....
42	.....	.....	.....	.....
44	.....	.....	.....	.....
45	1.3823	1.0420	1.0997	.....
46	.....	.....	.....	.....
48	.....	.....	.....	.....
50	.....	1.0440	1.1122	.....
55	.....	1.0460	1.1249	.....
60	.....	1.0470	.....	.....
65	.....	1.0470	.....	.....
70	.....	1.0460	.....	.....
75	.....	1.0430	.....	.....
80	.....	1.0400	.....	.....

SPECIFIC GRAVITY OF AQUEOUS SOLUTIONS
(Continued)

Per cent by weight	$NaC_2H_3O_2$ $\frac{20°}{4°}$ C.	$NaClO_4$ $\frac{18°}{4°}$ C.	$Ni(NO_3)_2$ $\frac{18°}{4°}$ C.	$Pb(C_2H_3O_2)_2$ $\frac{18°}{4°}$ C.
1	1.0033	1.0051	1.0070	1.0061
2	1.0084	1.0116	1.0155	1.0137
3	.....	.....	.....	.....
4	1.0186	1.0247	1.0330	1.0290
5	.....	.....	.....	.....
6	1.0289	1.0381	1.0508	1.0446
7	.....	.....	.....	.....
8	1.0392	1.0517	1.0693	1.0605
9	.....	.....	.....	.....
10	1.0495	1.0656	1.0882	1.0768
11	.....	.....	.....	.....
12	1.0598	1.0798	1.1076	1.0936
13	.....	.....	.....	.....
14	1.0702	1.0943	1.1277	1.1109
15	.....	.....	.....	.....
16	1.0807	1.1090	1.1484	1.1283
17	.....	.....	.....	.....
18	1.0913	1.1241	1.1696	1.1473
19	.....	.....	.....	.....
20	1.1021	1.1396	1.1914	1.1663
21	.....	.....	.....	.....
22	1.1130	1.1554	.....	1.1860
23	.....	.....	.....	.....
24	1.1240	1.1717	.....	1.2063
25	.....	.....	1.2493	.....
26	1.1351	1.1883	.....	1.2273
27	.....	.....	.....	.....
28	1.1462	1.2053	.....	1.2489
29	.....	.....	.....	.....
30	.....	1.2227	1.3114	1.2711
31	.....	.....	.....	.....
32	.....	1.2407	.....	.....
33	.....	.....	.....	.....
34	.....	1.2591	.....	.....
35	.....	.....	1.3777	1.3304
36	.....	1.2779	.....	.....
37	.....	.....	.....	.....
38	.....	1.2969	.....	.....
39	.....	.....	.....	.....
40	.....	.....	.....	1.3994
42	.....	.....	.....	.....
44	.....	.....	.....	.....
45	.....	.....	.....	.....
46	.....	.....	.....	.....
48	.....	.....	.....	.....
50	.....	.....	.....	.....
55	.....	.....	.....	.....
60	.....	.....	.....	.....
65	.....	.....	.....	.....
70	.....	.....	.....	.....
75	.....	.....	.....	.....
80	.....	.....	.....	.....

SPECIFIC GRAVITY OF AQUEOUS SOLUTIONS
(Continued)

Per cent by weight	$Pb(NO_3)_2$ $\frac{18^\circ}{4^\circ}$ C.	SO_2 $\frac{15.5^\circ}{4^\circ}$ C	$SrBr_2$ $\frac{20^\circ}{4^\circ}$ C.	$SrCl_2$ $\frac{20^\circ}{4^\circ}$ C.
1	1.0074	1.0040	.....	.....
2	1.0163	1.0091	1.0157	1.0161
3	.....	.....	.....	.....
4	1.0344	1.0191	1.0337	1.0344
5	.....	.....	.....	.....
6	1.0529	1.0292	1.0522	1.0532
7	.....	.....	.....	.....
8	1.0720	1.0393	1.0712	1.0726
9	.....	.....	.....	.....
10	1.0918	1.0493	1.0907	1.0925
11	.....	.....	.....	.....
12	1.1123	.....	1.1109	1.1130
13	.....	.....	.....	.....
14	1.1336	.....	1.1317	1.1341
15	.....	.....	.....	.....
16	1.1557	.....	1.1532	1.1558
17	.....	.....	.....	.....
18	1.1789	.....	1.1757	1.1781
19	.....	.....	.....	.....
20	1.2030	.....	1.1992	1.2010
21	.....	.....	.....	.....
22	1.2277	.....	.....	.....
23	.....	.....	.....	.....
24	1.2529	.....	.....	.....
25	.....	.....	1.2620	1.2600
26	1.2783	.....	.....	.....
27	.....	.....	.....	.....
28	1.3037	.....	.....	.....
29	.....	.....	.....	.....
30	1.3289	.....	1.3300	1.3250
31	.....	.....	.....	.....
32	.....	.....	.....	.....
33	.....	.....	.....	.....
34	.....	.....	.....	.....
35	.....	.....	1.4050	1.3960
36	.....	.....	.....	.....
37	.....	.....	.....	.....
38	.....	.....	.....	.....
39	.....	.....	.....	.....
40	.....	.....	1.4890	....
42	.....	.....	.....	.....
44	.....	.....	.....	.....
45	.....	.....	1.5830	.....
46	.....	.....	.....	.....
48	.....	.....	.....	.....
50	.....	.....	1.6860	.....
55	.....	.....	.....	.....
60	.....	.....	.....	.....
65	.....	.....	.....	.....
70	.....	.....	.....	.....
75	.....	.....	.....	.....
80	.....	.....	.....	.....

SPECIFIC GRAVITY OF AQUEOUS SOLUTIONS
(Continued)

Per cent by weight	SrI_2 $\frac{20°}{4°}$ C.	$Sr(NO_3)_2$ $\frac{20°}{4°}$ C.	$ZnBr_2$ $\frac{20°}{4°}$ C.	ZnI_2 $\frac{20°}{4°}$ C.
1	.....	.....	.....	.....
2	1.0154	1.0150	1.0167	1.016
3	.....	.....	.....	.....
4	1.0331	1.0310	1.0354	1.034
5	.....	.....	.....	.....
6	1.0513	1.0480	1.0544	1.053
7	.....	.....	.....	.....
8	1.0701	1.0650	1.0738	1.072
9	.....	.....	.....	.....
10	1.0896	1.0830	1.0935	1.091
11	.....	.....	.....	.....
12	1.1099	1.1010	1.1135	1.111
13	.....	.....	.....	.....
14	1.1308	1.1190	1.1338	1.131
15	.....	.....	.....	.....
16	1.1526	1.1380	1.1544	1.152
17	.....	.....	.....	.....
18	1.1753	1.1580	1.1753	1.174
19	.....	.....	.....	.....
20	1.1990	1.179	1.1965	1.197
21	.....	.....	.....	.....
22	.....	.....	.....	.....
23	.....	.....	.....	.....
24	.....	.....	.....	.....
25	1.2608	1.233	1.2543	1.258
26	.....	.....	.....	.....
27	.....	.....	.....	.....
28	.....	.....	.....	.....
29	.....	.....	.....	.....
30	1.3295	1.290	1.3170	1.325
31	.....	.....	.....	.....
32	.....	.....	.....	.....
33	.....	.....	.....	.....
34	.....	.....	.....	.....
35	1.4058	1.352	1.3859	1.398
36	.....	.....	.....	.....
37	.....	.....	.....	.....
38	.....	.....	.....	.....
39	.....	.....	.....	.....
40	1.4904	1.419	1.4620	1.478
42	.....	.....	.....	.....
44	.....	.....	.....	.....
45	1.5844	.....	1.5470	1.566
46	.....	.....	.....	.....
48	.....	.....	.....	.....
50	.....	.....	1.6430	1.663
55	.....	.....	1.7500	1.770
60	.....	.....	1.8690	1.893
65	.....	.....	2.0020	2.036
70	.....	.....	.....	2.202
75	.....	.....	.....	2.393
80	.....	.....	.....	.....

ETHYL ALCOHOL

Specific Gravity of Mixtures of Ethyl Alcohol and Water by Volume and by Weight

Giving the specific gravity at 15.56° C. referred to water at the same temperature. To reduce to specific gravity referred to water at 4° C. multiply by 0.9990

(U. S. Department of Agriculture.)

Specific gravity.	Per cent alcohol by volume.	Per cent alcohol by weight.	Grams alcohol per 100 c.c.	Specific gravity.	Per cent alcohol by volume.	Per cent alcohol by weight.	Gram alcoho per 100 c.c
1.00000	0.00	0.00	0.00	0.99431	3.90	3.12	3.10
0.99984	0.10	0.08	0.08	0.99417	4.00	3.20	3.18
0.99968	0.20	0.16	0.16	0.99403	4.10	3.28	3.26
0.99953	0.30	0.24	0.24	0.99390	4.20	3.36	3.34
0.99937	0.40	0.32	0.32	0.99376	4.30	3.44	3.42
0.99923	0.50	0.40	0.40	0.99363	4.40	3.52	3.50
0.99907	0.60	0.48	0.48	0.99349	4.50	3.60	3.58
0.99892	0.70	0.56	0.56	0.99335	4.60	3.68	3.66
0.99877	0.80	0.64	0.64	0.99322	4.70	3.76	3.74
0.99861	0.90	0.71	0.71	0.99308	4.80	3.84	3.81
0.99849	1.00	0.79	0.79	0.99295	4.90	3.92	3.89
0.99834	1.10	0.87	0.87	0.99281	5.00	4.00	3.97
0.99819	1.20	0.95	0.95	0.99268	5.10	4.08	4.05
0.99805	1.30	1.03	1.03	0.99255	5.20	4.16	4.13
0.99790	1.40	1.11	1.11	0.99241	5.30	4.24	4.21
0.99775	1.50	1.19	1.19	0.99228	5.40	4.32	4.29
0.99760	1.60	1.27	1.27	0.99215	5.50	4.40	4.37
0.99745	1.70	1.35	1.35	0.99202	5.60	4.48	4.44
0.99731	1.80	1.43	1.43	0.99189	5.70	4.56	4.52
0.99716	1.90	1.51	1.51	0.99175	5.80	4.64	4.60
0.99701	2.00	1.59	1.59	0.99162	5.90	4.72	4.68
0.99687	2.10	1.67	1.66	0.99149	6.00	4.80	4.76
0.99672	2.20	1.75	1.74	0.99136	6.10	4.88	4.84
0.99658	2.30	1.83	1.82	0.99123	6.20	4.96	4.93
0.99643	2.40	1.91	1.90	0.99111	6.30	5.05	5.01
0.99629	2.50	1.99	1.98	0.99098	6.40	5.13	5.09
0.99615	2.60	2.07	2.06	0.99085	6.50	5.21	5.17
0.99600	2.70	2.15	2.14	0.99072	6.60	5.29	5.25
0.99586	2.80	2.23	2.22	0.99059	6.70	5.37	5.33
0.99571	2.90	2.31	2.30	0.99047	6.80	5.45	5.41
0.99557	3.00	2.39	2.38	0.99034	6.90	5.53	5.49
0.99543	3.10	2.47	2.46	0.99021	7.00	5.61	5.57
0.99529	3.20	2.55	2.54	0.99009	7.10	5.69	5.65
0.99515	3.30	2.64	2.62	0.98996	7.20	5.77	5.73
0.99501	3.40	2.72	2.70	0.98984	7.30	5.86	5.81
0.99487	3.50	2.80	2.78	0.98971	7.40	5.94	5.89
0.99473	3.60	2.88	2.86	0.98959	7.50	6.02	5.97
0.99459	3.70	2.96	2.94	0.98947	7.60	6.10	6.05
0.99445	3.80	3.04	3.02	0.98934	7.70	6.18	6.13

ETHYL ALCOHOL (Continued)

Specific Gravity of Mixtures of Ethyl Alcohol and Water by Volume and by Weight

Specific gravity.	Per cent alcohol by volume.	Per cent alcohol by weight.	Grams alcohol per 100 c.c.	Specific gravity.	Per cent alcohol by volume.	Per cent alcohol by weight.	Grams alcohol per 100 c.c.
0.98922	7.80	6.26	6.19	0.98435	12.00	9.67	9.52
0.98909	7.90	6.34	6.27	0.98424	12.10	9.75	9.60
0.98897	8.00	6.42	6.35	0.98413	12.20	9.83	9.68
0.98885	8.10	6.50	6.43	0.98402	12.30	9.92	9.76
0.98873	8.20	6.58	6.51	0.98391	12.40	10.00	9.84
0.98861	8.30	6.67	6.59	0.98381	12.50	10.08	9.92
0.98849	8.40	6.75	6.67	0.98370	12.60	10.16	10.00
0.98837	8.50	6.83	6.75	0.98359	12.70	10.24	10.07
0.98825	8.60	6.91	6.83	0.98348	12.80	10.33	10.15
0.98813	8.70	6.99	6.91	0.98337	12.90	10.41	10.23
0.98801	8.80	7.07	6.99	0.98326	13.00	10.49	10.31
0.98789	8.90	7.15	7.07	0.98315	13.10	10.57	10.39
0.98777	9.00	7.23	7.14	0.98305	13.20	10.65	10.47
0.98765	9.10	7.31	7.22	0.98294	13.30	10.74	10.55
0.98754	9.20	7.39	7.30	0.98283	13.40	10.82	10.63
0.98742	9.30	7.48	7.38	0.98273	13.50	10.90	10.71
0.98730	9.40	7.56	7.46	0.98262	13.60	10.98	10.79
0.99719	9.50	7.64	7.54	0.98251	13.70	11.06	10.87
0.98707	9.60	7.72	7.62	0.98240	13.80	11.15	10.95
0.98695	9.70	7.80	7.70	0.98230	13.90	11.23	11.03
0.98683	9.80	7.88	7.78	0.98219	14.00	11.31	11.11
0.98672	9.90	7.96	7.85	0.98209	14.10	11.39	11.19
0.98660	10.00	8.04	7.93	0.98198	14.20	11.47	11.27
0.98649	10.10	8.12	8.01	0.98188	14.30	11.56	11.35
0.98637	10.20	8.20	8.09	0.98177	14.40	11.64	11.43
0.98626	10.30	8.29	8.17	0.98167	14.50	11.72	11.51
0.98614	10.40	8.37	8.25	0.98156	14.60	11.80	11.59
0.98603	10.50	8.45	8.33	0.98146	14.70	11.88	11.67
0.98592	10 60	8.53	8.41	0.98135	14.80	11.97	11.75
0.98580	10.70	8.61	8.49	0.98125	14.90	12.05	11.82
0.98569	10.80	8.70	8.57	0 98114	15.00	12.13	11.90
0.98557	10.90	8.78	8.65	0.98104	15.10	12.21	11.98
0.98546	11.00	8.86	8.73	0.98093	15.20	12.29	12.06
0.98535	11.10	8.94	8.81	0.98083	15.30	12.38	12.14
0.98524	11.20	9.02	8.89	0.98073	15.40	12.46	12.22
0.98513	11.30	9.11	8.97	0.98063	15.50	12.54	12.30
0.98502	11 40	9.19	9.05	0.98052	15.60	12.62	12.37
0.98491	11.50	9.27	9.13	0.98042	15.70	12.70	12.45
0.98479	11.60	9.35	9.21	0.98032	15.80	12.79	12.53
0.98468	11.70	9.43	9.29	0.98021	15.90	12.87	12.61
0.98457	11.80	9.51	9.36	0.98011	16.00	12.95	12.69
0.98446	11.90	9.59	9.44	0.98001	16.10	13.03	12.77

ETHYL ALCOHOL (Continued)

Specific Gravity of Mixtures of Ethyl Alcohol and Water by Volume and by Weight

Specific gravity.	Per cent alcohol by volume.	Per cent alcohol by weight.	Grams alcohol per 100 c.c.	Specific gravity.	Per cent alcohol by volume.	Per cent alcohol by weight.	Grams alcohol per 100 c.c.
0.97991	16.20	13.12	12.85	0.97568	20.40	16.59	16.18
0.97980	16.30	13.20	12.93	0.97558	20.50	16.67	16.26
0.97970	16.40	13.29	13.01	0.97547	20.60	16.75	16.34
0.97960	16.50	13.37	13.09	0.97537	20.70	16.84	16.42
0.97950	16.60	13.45	13.17	0.97527	20.80	16.92	16.50
0.97940	16.70	13.53	13.25	0.97517	20.90	17.01	16.58
0.97929	16.80	13.62	13.33	0.97507	21.00	17.09	16.66
0.97917	16.90	13.70	13.41	0.97497	21.10	17.17	16.74
0.97909	17.00	13.78	13.49	0.97487	21.20	17.26	16.82
0.97899	17.10	13.86	13.57	0.97477	21.30	17.34	16.90
0.97889	17.20	13.94	13.65	0.97467	21.40	17.43	16.98
0.97879	17.30	14.03	13.73	0.97457	21.50	17.51	17.06
0.97869	17.40	14.11	13.81	0.97446	21.60	17.59	17.14
0.97859	17.50	14.19	13.89	0.97436	21.70	17.67	17.22
0.97848	17.60	14.27	13.96	0.97426	21.80	17.76	17.30
0.97838	17.70	14.35	14.04	0.97416	21.90	17.84	17.38
0.97828	17.80	14.44	14.12	0.97406	22.00	17.92	17.46
0.97818	17.90	14.52	14.20	0.97396	22.10	18.00	17.54
0.97808	18.00	14.60	14.28	0.97386	22.20	18.09	17.62
0.97798	18.10	14.68	14.36	0.97375	22.30	18.17	17.70
0.97788	18.20	14.77	14.44	0.97365	22.40	18.26	17.78
0.97778	18.30	14.85	14.52	0.97355	22.50	18.34	17.86
0.97768	18.40	14.94	14.60	0.97345	22.60	18.42	17.94
0.97758	18.50	15.02	14.68	0.97335	22.70	18.51	18.02
0.97748	18.60	15.10	14.76	0.97324	22.80	18.59	18.10
0.97738	18.70	15.18	14.84	0.97314	22.90	18.68	18.18
0.97728	18.80	15.27	14.92	0.97304	23.00	18.76	18.26
0.97718	18.90	15.38	15.00	0.97294	23.10	18.84	18.34
0.97708	19.00	15.43	15.08	0.97283	23.20	18.92	18.41
0.97698	19.10	15.51	15.15	0.97273	23.30	19.01	18.49
0.97688	19.20	15.59	15.23	0.97263	23.40	19.09	18.57
0.97678	19.30	15.68	15.31	0.97253	23.50	19.17	18.65
0.97668	19.40	15.76	15.39	0.97242	23.60	19.25	18.73
0.97658	19.50	15.84	15.47	0.97232	23.70	19.34	18.81
0.97648	19.60	15.93	15.55	0.97222	23.80	19.42	18.88
0.97638	19.70	16.01	15.63	0.97211	23.90	19.51	18.96
0.97628	19.80	16.09	15.71	0.97201	24.00	19.59	19.04
0.97618	19.90	16.18	15.79	0.97191	24.10	19.67	19.12
0.97608	20.00	16.26	15.87	0.97180	24.20	19.76	19.20
0.97598	20.10	16.34	15.95	0.97170	24.30	19.84	19.28
0.97588	20.20	16.42	16.03	0.97159	24.40	19.93	19.36
0.97578	20.30	16.51	16.10	0.97149	24.50	20.01	19.44

ETHYL ALCOHOL (Continued)

Specific Gravity of Mixtures of Ethyl Alcohol and Water by Volume and by Weight

Specific gravity.	Per cent alcohol by volume.	Per cent alcohol by weight.	Grams alcohol per 100 c.c.	Specific gravity.	Per cent alcohol by volume.	Per cent alcohol by weight.	Grams alcohol per 100 c.c.
0.97139	24.60	20.09	19.52	0.96681	28.80	23.64	22.85
0.97128	24.70	20.18	19.60	0.96669	28.90	23.72	22.99
0.97118	24.80	20.26	19.68	0.96658	29.00	23.81	23.01
0.97107	24.90	20.35	19.76	0.96646	29.10	23.89	23.09
0.97097	25.00	20.43	19.84	0.96635	29.20	23.98	23.17
0.97086	25.10	20.51	19.92	0.96623	29.30	24.06	23.25
0.97076	25.20	20.60	20.00	0.96611	29.40	24.15	23.33
0.97065	25.30	20.68	20.08	0.96600	29.50	24.23	23.41
0.97055	25.40	20.77	20.16	0.96587	29.60	24.32	23.49
0.97044	25.50	20.85	20.24	0.96576	29.70	24.40	23 57
0.97033	25.60	20.93	20.32	0.96564	29.80	24.49	23.65
0.97023	25.70	21.02	20.40	0.96553	29.90	24.57	23.73
0.97012	25.80	21.10	20.47	0.96541	30.00	24.66	23.81
0.97001	25.90	21.19	20.55	0.96529	30.10	24.74	23.89
0.96991	26.00	21.27	20.63	0.96517	30.20	24.83	23.97
0.96980	26.10	21.35	20.71	0.96505	30.30	24.91	24.04
0.96969	26.20	21.44	20.79	0.96493	30.40	25.00	24.12
0.96959	26.30	21.52	20.87	0.96481	30.50	25.08	24.20
0.96949	26.40	21.61	20.95	0.96469	30.60	25.17	24.28
0.96937	26.50	21.69	21.03	0.96457	30.70	25.25	24.36
0.96926	26.60	21.77	21.11	0.96445	30.80	25.34	24.44
0.96915	26.70	21.86	21.19	0.96433	30.90	25.42	24.52
0.96905	26.80	21.94	21.27	0.96421	31.00	25.51	24.60
0.96894	26.90	22.03	21.35	0.96409	31.10	25.60	24.68
0.96883	27.00	22.11	21.43	0.96396	31.20	25.68	24.76
0.96872	27.10	22.20	21.51	0.96384	31.30	25.77	24.84
0.96861	27.20	22.28	21.59	0.96372	31.40	25.85	24.92
0.96850	27.30	22.37	21.67	0.96360	31.50	25.94	25.00
0.96839	27.40	22.45	21.75	0.96347	31.60	26.03	25.08
0.96828	27.50	22.54	21.83	0.96335	31.70	26.11	25.16
0.96816	27.60	22.62	21.90	0.96323	31.80	26.20	25.24
0.96805	27.70	22.71	21.98	0.96310	31.90	26.28	25.32
0.96794	27.80	22.79	22.06	0.96298	32.00	26.37	25.40
0.96783	27.90	22.88	22.14	0.96285	32.10	26.46	25.48
0.96772	28.00	22.96	22.22	0.96273	32.20	26.54	25.56
0.96761	28.10	23.04	22.30	0.96260	32.30	26.63	25.64
0.96749	28.20	23.13	22.38	0.96248	32.40	26.71	25.71
0.96738	28.30	23.21	22.45	0.96235	32.50	26.80	25.79
0.96726	28.40	23.30	22.53	0.96222	32.60	26.89	25.87
0.96715	28.50	23.38	22.61	0.96210	32.70	26.97	25.95
0.96704	28.60	23.47	22.69	0.96197	32.80	27.06	26.03
0.96692	28.70	23.55	22.77	0.96185	32.90	27.14	26.11

ETHYL ALCOHOL (Continued)

Specific Gravity of Mixtures of Ethyl Alcohol and Water by Volume and by Weight

Specific gravity.	Per cent alcohol by volume.	Per cent alcohol by weight.	Grams alcohol per 100 c.c.	Specific gravity.	Per cent alcohol by volume.	Per cent alcohol by weight.	Grams alcohol per 100 c.c.
0.96172	33.00	27.23	26.19	0.95603	37.20	30.88	29.52
0.96159	33.10	27.32	26.27	0.95589	37.30	30.96	29.60
0.96146	33.20	27.40	26.35	0.95574	37.40	31.05	29.68
0.96133	33.30	27.49	26.43	0.95560	37.50	31.14	29.76
0.96120	33.40	27.57	26.51	0.95545	37.60	31.23	29.84
0.96108	33.50	27.66	26.59	0.95531	37.70	31.32	29.92
0.96095	33.60	27.75	26.67	0.95516	37.80	31.40	30.00
0.96082	33.70	27.83	26.75	0.95502	37.90	31.49	30.08
0.96069	33.80	27.92	26.82	0.95487	38.00	31.58	30.16
0.96056	33.90	28.00	26.90	0.95472	38.10	31.67	30.24
0.96043	34.00	28.09	26.98	0.95457	38.20	31.76	30.32
0.96030	34.10	28.18	27.06	0.95442	38.30	31.85	30.40
0.96016	34.20	28.26	27.14	0.95427	38.40	31.94	30.48
0.96003	34.30	28.35	27.22	0.95413	38.50	32.03	30.56
0.95990	34.40	28.43	27.30	0.95398	38.60	32.12	30.64
0.95977	34.50	28.52	27.38	0.95383	38.70	32.20	30.72
0.95963	34.60	28.61	27.46	0.95368	38.80	32.29	30.79
0.95950	34.70	28.70	27.54	0.95353	38.90	32.37	30.87
0.95937	34.80	28.78	27.62	0.95338	39.00	32.46	30.95
0.95923	34.90	28.87	27.70	0.95323	39.10	32.55	31.03
0.95910	35.00	28.96	27.78	0.95307	39.20	32.64	31.11
0.95896	35.10	29.05	27.86	0.95292	39.30	32.72	31.19
0.95883	35.20	29.13	27.94	0.95277	39.40	32.81	31.27
0.95869	35.30	29.22	28.02	0.95262	39.50	32.90	31.35
0.95855	35.40	29.30	28.09	0.95246	39.60	32.99	31.43
0.95842	35.50	29.38	28.17	0.95231	39.70	33.08	31.51
0.95828	35.60	29.48	28.25	0.95216	39.80	33.17	31.59
0.95814	35.70	29.57	28.33	0.95200	39.90	33.27	31.67
0.95800	35.80	29.65	28.41	0.95185	40.00	33.35	31.75
0.95787	35.90	29.74	28.49	0.95169	40.10	33.44	31.83
0.95773	36.00	29.83	28.57	0.95154	40.20	33.53	31.91
0.95759	36.10	29.92	28.65	0.95138	40.30	33.61	31.99
0.95745	36.20	30.00	28.73	0.95122	40.40	33.70	32.07
0.95731	36.30	30.09	28.81	0.95107	40.50	33.79	32.15
0.95717	36.40	30.17	28.88	0.95091	40.60	33.88	32.23
0.95703	36.50	30.26	28.96	0.95075	40.70	33.97	32.31
0.95688	36.60	30.35	29.04	0.95059	40.80	34.06	32.39
0.95674	36.70	30.44	29.12	0.95044	40.90	34.15	32.47
0.95660	36.80	30.52	29.20	0.95028	41.00	34.24	32.55
0.95646	36.90	30.61	29.29	0.95012	41.10	34.33	32.63
0.95632	37.00	30.70	29.36	0.94996	41.20	34.42	32.71
0.95618	37.10	30.79	29.44	0.94980	41.30	34.50	32.79

ETHYL ALCOHOL (Continued)

Specific Gravity of Mixtures of Ethyl Alcohol and Water by Volume and by Weight

Specific gravity.	Per cent alcohol by volume.	Per cent alcohol by weight.	Grams alcohol per 100 c.c.	Specific gravity.	Per cent alcohol by volume.	Per cent alcohol by weight.	Grams alcohol per 100 c.c.
0.94964	41.40	34.59	32.86	0.94258	45.60	38.39	36.19
0.94948	41.50	34.68	32.93	0.94241	45.70	38.48	36.26
0.94932	41.60	34.77	33.01	0.94223	45.80	38.57	36.34
0.94916	41.70	34.86	33.09	0.94206	45.90	38.66	36.42
0.94900	41.80	34.95	33.17	0.94188	46.00	38.75	36.50
0.94884	41.90	35.04	33.25	0.94170	46.10	38.84	36.58
0.94868	42.00	35.13	33.33	0.94152	46.20	38.93	36.66
0.94852	42.10	35.22	33.41	0.94134	46.30	39.03	36.74
0.94835	42.20	35.31	33.49	0.94116	46.40	39.12	36.82
0.94810	42.30	35.40	33.57	0.94098	46.50	39.21	36.90
0.94802	42.40	35.49	33.65	0.94080	46.60	39.30	36.98
0.94786	42.50	35.58	33.73	0.94062	46.70	39.39	37.06
0.94770	42.60	35.67	33.81	0.94044	46.80	39.49	37.13
0.94753	42.70	35.76	33.89	0.94026	46.90	39.58	37.21
0.94737	42.80	35.85	33.97	0.94008	47.00	39.67	37.29
0.94720	42.90	35.94	34.04	0.93990	47.10	39.76	37.37
0.94704	43.00	36.03	34.12	0.93971	47.20	39.85	37.45
0.94687	43.10	36.12	34.20	0.93953	47.30	39.95	37.53
0.94670	43.20	36.21	34.23	0.93934	47.40	40.04	37.61
0.94654	43.30	36.30	34.36	0.93916	47.50	40.13	37.69
0.94637	43.40	36.39	34.44	0.93898	47.60	40.22	37.77
0.94620	43.50	36.48	34.52	0.93879	47.70	40.32	37.85
0.94603	43.60	36.57	34.60	0.93861	47.80	40.41	37.93
0.94586	43.70	36.66	34.68	0.93842	47.90	40.51	38.01
0.94570	43.80	36.75	34.76	0.93824	48.00	40.60	38.09
0.94553	43.90	36.84	34.84	0.93805	48.10	40.69	38.17
0.94536	44.00	36.93	34.91	0.93786	48.20	40.78	38.25
0.94519	44.10	37.02	34.99	0.93768	48.30	40.88	38.33
0.94502	44.20	37.11	35.07	0.93749	48.40	40.97	38.41
0.94484	44.30	37.21	35.15	0.93730	48.50	41.06	38.49
0.94467	44.40	37.30	35.23	0.93711	48.60	41.15	38.57
0.94450	44.50	37.39	35.31	0.93692	48.70	41.24	38.65
0.94433	44.60	37.48	35.39	0.93679	48.80	41.34	38.72
0.94416	44.70	37.57	35.47	0.93655	48.90	41.43	38.80
0.94398	44.80	37.66	35.55	0.93636	49.00	41.52	38.88
0.94381	44.90	37.76	35.63	0.93617	49.10	41.61	38.96
0.94364	45.00	37.84	35.71	0.93598	49.20	41.71	39.04
0.94346	45.10	37.93	35.79	0.93578	49.30	41.80	39.12
0.94329	45.20	38.02	35.87	0.93559	49.40	41.90	39.20
0.94311	45.30	38.12	35.95	0.93540	49.50	41.99	39.28
0.94294	45.40	38.21	36.03	0.93521	49.60	42.08	39.36
0.94276	45.50	38.30	36.11	0.93502	49.70	42.18	39.44

ETHYL ALCOHOL (Continued)

Specific Gravity of Mixtures of Ethyl Alcohol and Water by Volume and by Weight

Specific gravity.	Per cent alcohol by volume.	Per cent alcohol by weight.	Grams alcohol per 100 c.c.	Specific gravity.	Per cent alcohol by volume.	Per cent alcohol by weight.	Grams alcohol per 100 c.c.
0.93482	49.80	42.27	39.52	0.8773	75.00	....	....
0.93463	49.90	42.37	39.60	0.8747	76.00	....	....
0.9344	50.00	....*	....	0.8721	77.00	....	....
0.9325	51.00	....	....	0.8694	78.00	....	....
0.9305	52.00	....	....	0.8667	79.00	....	....
0.9285	53.00	....	....	0.8639	80.00	....	....
0.9264	54.00	....	....	0.8611	81.00	....	....
0.9244	55.00	....	....	0.8583	82.00	....	....
0.9222	56.00	....	....	0.8554	83.00	....	....
0.9201	57.00	....	....	0.8525	84.00	....	....
0.9180	58.00	....	....	0.8496	85.00	....	....
0.9158	59.00	....	....	0.8465	86.00	....	....
0.9136	60.00	....	....	0.8435	87.00	....	....
0.9113	61.00	....	....	0.8404	88.00	....	....
0.9091	62.00	....	....	0.8372	89.00	....	....
0.9068	63.00	....	....	0.8339	90.00	....	....
0.9044	64.00	....	....	0.8306	91.00	....	....
0.9021	65.00	....	....	0.8272	92.00	....	....
0.8997	66.00	....	....	0.8236	93.00	....	....
0.8974	67.00	....	....	0.8199	94.00	....	....
0.8949	68.00	....	....	0.8161	95.00	....	....
0.8925	69.00	....	....	0.8121	96.00	....	....
0.8900	70.00	....	....	0.8079	97.00	....	....
0.8876	71.00	....	....	0.8035	98.00	....	....
0.8850	72.00	....	....	0.7989	99.00	....	....
0.8825	73.00	....	....	0.7939	100.00	....	....
0.8799	74.00	....	....	.....	.....	....	....

* For specific gravity of mixtures by weight see following table.

ETHYL ALCOHOL

Specific Gravity of Mixtures of Ethyl Alcohol and Water by Weight

The table gives the specific gravity at the temperature indicated referred to water at 4° C.

(U. S. Bureau of Standards.)

Per cent alcohol by weight.	15° C.	20° C.	25° C.	Per cent alcohol by weight.	15° C.	20° C.	25° C.
0	0.99913	0.99824	0.99708	51	0.91566	0.91164	0.90758
1	0.99725	0.99636	0.99521	52	0.91344	0.90940	0.90533
2	0.99543	0.99453	0.99338	53	0.91120	0.90715	0.90307
3	0.99366	0.99274	0.99159	54	0.90895	0.90488	0.90079
4	0.99197	0.99102	0.98984	55	0.90670	0.90262	0.89851
5	0.99033	0.98936	0.98815	56	0.90443	0.90034	0.89622
6	0.98877	0.98776	0.98651	57	0.90215	0.89805	0.89392
7	0.98726	0.98620	0.98491	58	0.89987	0.89576	0.89162
8	0.98581	0.98470	0.98336	59	0.89758	0.89346	0.88931
9	0.98442	0.98325	0.98185	60	0.89528	0.89115	0.88700
10	0.98307	0.98185	0.98038	61	0.89297	0.88883	0.88467
11	0.98176	0.98047	0.97893	62	0.89066	0.88651	0.88234
12	0.98049	0.97913	0.97752	63	0.88834	0.88418	0.88000
13	0.97925	0.97781	0.97612	64	0.88601	0.88185	0.87766
14	0.97803	0.97651	0.97474	65	0.88368	0.87950	0.87530
15	0.97683	0.97522	0.97336	66	0.88134	0.87716	0.87295
16	0.97563	0.97393	0.97199	67	0.87899	0.87480	0.87058
17	0.97444	0.97264	0.97061	68	0.87664	0.87244	0.86821
18	0.97324	0.97134	0.96922	69	0.87428	0.87008	0.86583
19	0.97203	0.97003	0.96782	70	0.87192	0.86770	0.86344
20	0.97080	0.96870	0.96640	71	0.86954	0.86532	0.86105
21	0.96956	0.96736	0.96497	72	0.86716	0.86292	0.85864
22	0.96829	0.96599	0.96352	73	0.86477	0.86052	0.85622
23	0.96699	0.96459	0.96203	74	0.86237	0.85812	0.85380
24	0.96566	0.96317	0.96052	75	0.85997	0.85570	0.85137
25	0.96430	0.96171	0.95897	76	0.85755	0.85328	0.84893
26	0.96289	0.96021	0.95739	77	0.85513	0.85084	0.84648
27	0.96145	0.95868	0.95577	78	0.85270	0.84840	0.84403
28	0.95997	0.95711	0.95412	79	0.85026	0.84595	0.84157
29	0.95845	0.95550	0.95244	80	0.84781	0.84349	0.83909
30	0.95688	0.95385	0.95071	81	0.84534	0.84101	0.83660
31	0.95526	0.95215	0.94894	82	0.84286	0.83852	0.83410
32	0.95360	0.95042	0.94713	83	0.84037	0.83602	0.83159
33	0.95191	0.94865	0.94529	84	0.83786	0.83350	0.82906
34	0.95017	0.94684	0.94342	85	0.83534	0.83097	0.82652
35	0.94839	0.94499	0.94152	86	0.83279	0.82842	0.82396
36	0.94657	0.94311	0.93957	87	0.83022	0.82583	0.82137
37	0.94471	0.94119	0.93760	88	0.82762	0.82323	0.81876
38	0.94282	0.93924	0.93560	89	0.82500	0.82060	0.81613
39	0.94089	0.93725	0.93356	90	0.82235	0.81795	0.81348
40	0.93893	0.93524	0.93151	91	0.81966	0.81527	0.81080
41	0.93694	0.93320	0.92943	92	0.81694	0.81255	0.80809
42	0.93491	0.93113	0.92732	93	0.81418	0.80979	0.80534
43	0.93286	0.92904	0.92519	94	0.81138	0.80700	0.80256
44	0.93078	0.92693	0.92305	95	0.80854	0.80417	0.79974
45	0.92868	0.92480	0.92088	96	0.80564	0.80129	0.79689
46	0.92655	0.92264	0.91870	97	0.80271	0.79838	0.79400
47	0.92441	0.92047	0.91650	98	0.79972	0.79541	0.79106
48	0.92225	0.91828	0.91429	99	0.79668	0.79240	0.78809
49	0.92006	0.91608	0.91207	100	0.79358	0.78933	0.78507
50	0.91787	0.91386	0.90983	.....	.....	.....	.....

ETHYL ALCOHOL

Specific Gravity of Aqueous Solutions Referred to Water at the Same Temperature

Per cent alcohol	Sp. gr. 15°/15° C.	Sp. gr. 20°/20° C.	Sp. gr. 25°/25° C.	Per cent alcohol	Sp. gr. 15°/15° C.	Sp. gr. 20°/20° C.	Sp. gr. 25°/25° C.
0	1.00000	1.00000	1.00000	51	0.91635	0.91322	0.91026
1	0.99812	0.99813	0.99811	52	0.91412	0.91097	0.90799
2	0.99629	0.99629	0.99627	53	0.91189	0.90872	0.90571
3	0.99451	0.99451	0.99447	54	0.90964	0.90645	0.90343
4	0.99281	0.99279	0.99274	55	0.90738	0.90418	0.90113
5	0.99118	0.99113	0.99106	56	0.90512	0.90191	0.89883
6	0.98963	0.98955	0.98945	57	0.90285	0.89962	0.89654
7	0.98815	0.98802	0.98788	58	0.90058	0.89733	0.89423
8	0.98670	0.98653	0.98634	59	0.89830	0.89502	0.89191
9	0.98528	0.98505	0.98481	60	0.89601	0.89271	0.88959
10	0.98390	0.98361	0.98330	61	0.89371	0.89040	0.88725
11	0.98256	0.98221	0.98184	62	0.89139	0.88807	0.88491
12	0.98126	0.98084	0.98039	63	0.88907	0.88574	0.88256
13	0.97999	0.97948	0.97897	64	0.88674	0.88339	0.88020
14	0.97875	0.97816	0.97757	65	0.88441	0.88104	0.87783
15	0.97754	0.97687	0.97619	66	0.88207	0.87869	0.87547
16	0.97637	0.97560	0.97484	67	0.87971	0.87632	0.87309
17	0.97518	0.97431	0.97346	68	0.87736	0.87396	0.87071
18	0.97398	0.97301	0.97207	69	0.87500	0.87158	0.86833
19	0.97276	0.97169	0.97065	70	0.87263	0.86920	0.86593
20	0.97152	0.97036	0.96922	71	0.87025	0.86680	0.86352
21	0.97028	0.96901	0.96778	72	0.86785	0.86440	0.86110
22	0.96902	0.96763	0.96630	73	0.86545	0.86200	0.85869
23	0.96773	0.96624	0.96481	74	0.86304	0.85958	0.85626
24	0.96642	0.96483	0.96329	75	0.86063	0.85716	0.85383
25	0.96508	0.96339	0.96176	76	0.85822	0.85473	0.85140
26	0.96371	0.96190	0.96018	77	0.85579	0.85230	0.84893
27	0.96228	0.96037	0.95856	78	0.85336	0.84985	0.84650
28	0.96080	0.95880	0.95689	79	0.85092	0.84740	0.84404
29	0.95927	0.95717	0.95520	80	0.84846	0.84494	0.84157
30	0.95769	0.95551	0.95345	81	0.84599	0.84245	0.83909
31	0.95607	0.95381	0.95168	82	0.84350	0.83997	0.83659
32	0.95440	0.95207	0.94986	83	0.84101	0.83747	0.83408
33	0.95269	0.95028	0.94802	84	0.83850	0.83496	0.83156
34	0.95094	0.94847	0.94613	85	0.83598	0.83242	0.82903
35	0.94915	0.94662	0.94422	86	0.83343	0.82987	0.82648
36	0.94732	0.94473	0.94227	87	0.83086	0.82729	0.82388
37	0.94546	0.94281	0.94031	88	0.82826	0.82469	0.82128
38	0.94355	0.94086	0.93830	89	0.82564	0.82207	0.81867
39	0.94161	0.93886	0.93626	90	0.82299	0.81942	0.81602
40	0.93964	0.93684	0.93421	91	0.82030	0.81674	0.81334
41	0.93764	0.93479	0.93212	92	0.81759	0.81401	0.81061
42	0.93559	0.93272	0.93001	93	0.81484	0.81127	0.80785
43	0.93352	0.93062	0.92787	94	0.81205	0.80848	0.80507
44	0.93143	0.92849	0.92571	95	0.80922	0.80567	0.80227
45	0.92933	0.92636	0.92355	96	0.80636	0.80280	0.79939
46	0.92721	0.92421	0.92137	97	0.80344	0.79988	0.79647
47	0.92506	0.92204	0.91917	98	0.80045	0.79688	0.79347
48	0.92291	0.91986	0.91697	99	0.79739	0.79383	0.79042
49	0.92075	0.91766	0.91475	100	0.79429	0.79074	0.78734
50	0.91856	0.91546	0.91251	.....	.....	.....	.....

METHYL ALCOHOL

Specific Gravity of Mixtures of Methyl Alcohol and Water by Volume and by Weight

Giving the specific gravity at 15°C referred to water at 4°C.

(Calculated from values by Doroshevski and Rozhdestvenski, Dittmar and Fawsitt.)

Per cent alcohol by weight	Per cent alcohol by volume	Specific gravity	Per cent alcohol by weight	Per cent alcohol by volume	Specific gravity
1	1.25	0.99727	51	58.74	0.91653
2	2.50	0.99543	52	59.76	0.91451
3	3.75	0.99370	53	60.77	0.91248
4	4.99	0.99198	54	61.78	0.91044
5	6.22	0.99029	55	62.78	0.90839
6	7.45	0.98864	56	63.78	0.90631
7	8.68	0.98701	57	64.77	0.90421
8	9.91	0.98547	58	65.75	0.90210
9	11.13	0.98394	59	66.73	0.89996
10	12.35	0.98241	60	67.69	0.89781
11	13.56	0.98093	61	68.65	0.89563
12	14.77	0.97945	62	69.61	0.89341
13	15.98	0.97802	63	70.55	0.89117
14	17.18	0.97660	64	71.49	0.88890
15	18.38	0.97518	65	72.42	0.88662
16	19.58	0.97377	66	73.34	0.88433
17	20.77	0.97237	67	74.26	0.88203
18	21.96	0.97096	68	75.17	0.87971
19	23.15	0.96955	69	78.08	0.87739
20	24.33	0.96814	70	76.98	0.87507
21	25.51	0.96673	71	77.86	0.87271
22	26.69	0.96533	72	78.75	0.87033
23	27.86	0.96392	73	79.62	0.86792
24	29.03	0.96251	74	80.48	0.86546
25	30.19	0.96108	75	81.34	0.86300
26	31.35	0.95963	76	82.18	0.86051
27	32.51	0.95817	77	83.02	0.85801
28	33.66	0.95668	78	83.86	0.85551
29	34.81	0.95518	79	84.68	0.85300
30	35.95	0.95366	80	85.50	0.85048
31	37.09	0.95213	81	86.31	0.84794
32	38.22	0.95056	82	87.11	0.84536
33	39.35	0.94896	83	87.90	0.84274
34	40.48	0.94734	84	88.68	0.84009
35	41.59	0.94570	85	89.45	0.83742
36	42.71	0.94404	86	90.21	0.83475
37	43.82	0.94237	87	90.97	0.83207
38	44.92	0.94067	88	91.72	0.82937
39	46.02	0.93894	89	92.46	0.82667
40	47.11	0.93720	90	93.19	0.82396
41	48.20	0.93543	91	93.92	0.82124
42	49.28	0.93365	92	94.63	0.81849
43	50.35	0.93185	93	95.33	0.81568
44	51.42	0.93001	94	96.02	0.81285
45	52.49	0.92815	95	96.70	0.80999
46	53.54	0.92627	96	97.37	0.80713
47	54.60	0.92436	97	98.04	0.80428
48	55.64	0.92242	98	98.70	0.80143
49	56.68	0.92048	99	99.35	0.79859
50	57.71	0.91852	100	100.00	0.79577

METHYL ALCOHOL

Specific Gravity of Mixtures of Methyl Alcohol and Water by Volume and by Weight

Giving the specific gravity at 15.6° C. referred to water at the same temperature. To reduce to specific gravity of water at 4°C. multiply by 0.9990

(Techn. Hogskolan, Stockholm.)

Specific gravity	Per cent alcohol by wt.	Per cent alcohol by vol.	Specific gravity	Per cent alcohol by wt.	Per cent alcohol by vol.	Specific gravity	Per cent alcohol by wt.	Per cent alcohol by vol.
1.0000	0.00	0.00	0.9950	2.72	3.48	0.9900	5.72	7.1
0.9999	0.06	0.07	0.9949	2.78	3.55	0.9899	5.78	7.2
0.9998	0.11	0.13	0.9948	2.84	3.62	0.9898	5.85	7.2
0.9997	0.17	0.20	0.9947	2.89	3.70	0.9897	5.91	7.3
0.9996	0.22	0.27	0.9946	2.95	3.77	0.9896	5.97	7.4
0.9995	0.28	0.33	0.9945	3.01	3.84	0.9895	6.04	7.5
0.9994	0.33	0.40	0.9944	3.07	3.91	0.9894	6.10	7.5
0.9993	0.39	0.47	0.9943	3.13	3.98	0.9893	6.16	7.6
0.9992	0.44	0.53	0.9942	3.18	4.06	0.9892	6.23	7.7
0.9991	0.50	0.60	0.9941	3.24	4.13	0.9891	6.29	7.8
0.9990	0.55	0.67	0.9940	3.30	4.20	0.9890	6.36	7.9
0.9989	0.61	0.73	0.9939	3.36	4.27	0.9889	6.42	7.9
0.9988	0.66	0.80	0.9938	3.42	4.35	0.9888	6.48	8.0
0.9987	0.72	0.86	0.9937	3.48	4.42	0.9887	6.55	8.1
0.9986	0.77	0.93	0.9936	3.53	4.49	0.9886	6.61	8.2
0.9985	0.83	1.00	0.9935	3.59	4.57	0.9885	6.67	8.2
0.9984	0.88	1.06	0.9934	3.65	4.64	0.9884	6.74	8.3
0.9983	0.94	1.13	0.9933	3.71	4.71	0.9883	6.80	8.4
0.9982	0.99	1.20	0.9932	3.77	4.79	0.9882	6.86	8.5
0.9981	1.05	1.26	0.9931	3.83	4.89	0.9881	6.93	8.5
0.9980	1.10	1.33	0.9930	3.89	4.94	0.9880	6.99	8.6
0.9979	1.15	1.40	0.9929	3.94	5.01	0.9879	7.06	8.7
0.9978	1.20	1.47	0.9928	4.00	5.08	0.9878	7.12	8.8
0.9977	1.26	1.54	0.9927	4.06	5.16	0.9877	7.19	8.9
0.9976	1.31	1.62	0.9926	4.12	5.23	0.9876	7.25	8.9
0.9975	1.36	1.69	0.9925	4.18	5.30	0.9875	7.32	9.0
0.9974	1.41	1.76	0.9924	4.24	5.38	0.9874	7.38	9.1
0.9973	1.46	1.83	0.9923	4.29	5.45	0.9873	7.45	9.2
0.9972	1.52	1.90	0.9922	4.35	5.52	0.9872	7.51	9.2
0.9971	1.57	1.97	0.9921	4.41	5.60	0.9871	7.58	9.3
0.9970	1.62	2.05	0.9920	4.57	5.67	0.9870	7.64	9.4
0.9969	1.67	2.12	0.9919	4.53	5.74	0.9869	7.71	9.3
0.9968	1.72	2.19	0.9918	4.60	5.82	0.9868	7.77	9.4
0.9967	1.78	2.26	0.9917	4.66	5.89	0.9867	7.84	9.4
0.9966	1.83	2.33	0.9916	4.72	5.96	0.9866	7.90	9.5
0.9965	1.88	2.40	0.9915	4.78	6.04	0.9865	7.97	9.3
0.9964	1.93	2.47	0.9914	4.85	6.11	0.9864	8.03	9.5
0.9963	1.98	2.55	0.9913	4.91	6.18	0.9863	8.10	10.
0.9962	2.04	2.62	0.9912	4.97	6.25	0.9862	8.16	10.
0.9961	2.09	2.69	0.9911	5.03	6.33	0.9861	8.23	10.
0.9960	2.14	2.76	0.9910	5.10	6.40	0.9860	8.29	10.
0.9959	2.20	2.83	0.9909	5.16	6.47	0.9859	8.35	10.
0.9958	2.26	2.90	0.9908	5.22	6.55	0.9858	8.42	10.
0.9957	2.31	2.98	0.9907	5.28	6.62	0.9857	8.48	10.
0.9956	2.37	3.05	0.9906	5.35	6.69	0.9856	8.55	10.
0.9955	2.43	3.12	0.9905	5.41	6.77	0.9855	8.61	10.
0.9954	2.49	3.19	0.9904	5.47	6.84	0.9854	8.68	10.
0.9953	2.55	3.26	0.9903	5.53	6.91	0.9853	8.74	10.
0.9952	2.60	3.34	0.9902	5.60	6.98	0.9852	8.81	10.
0.9951	2.66	3.41	0.9901	5.66	7.06	0.9851	8.87	10.

METHYL ALCOHOL (Continued)

SPECIFIC GRAVITY OF MIXTURES OF METHYL ALCOHOL AND WATER BY VOLUME AND BY WEIGHT

Specific gravity	Per cent alcohol by wt.	Per cent alcohol by vol.	Specific gravity	Per cent alcohol by wt.	Per cent alcohol by vol.	Specific gravity	Per cent alcohol by wt.	Per cent alcohol by vol.
0.9850	8.94	11.03	0.9796	12.55	15.46	0.9742	16.43	20.09
0.9849	9.00	11.10	0.9795	12.62	15.55	0.9741	16.51	20.17
0.9848	9.06	11.18	0.9794	12.69	15.63	0.9740	16.58	20.26
0.9847	9.13	11.26	0.9793	12.76	15.72	0.9739	16.65	20.35
0.9846	9.19	11.34	0.9792	12.83	15.80	0.9738	16.72	20.43
0.9845	9.26	11.42	0.9791	12.90	15.89	0.9737	16.79	20.52
0.9844	9.32	11.50	0.9790	12.97	15.87	0.9736	16.86	20.60
0.9843	9.39	11.58	0.9789	13.04	16.06	0.9735	16.93	20.69
0.9842	9.45	11.66	0.9788	13.11	16.14	0.9734	17.00	20.77
0.9841	9.52	11.74	0.9787	13.18	16.23	0.9733	17.07	20.86
0.9840	9.58	11.82	0.9786	13.25	16.31	0.9732	17.14	20.94
0.9839	9.65	11.90	0.9785	13.32	16.40	0.9731	17.21	21.03
0.9838	9.72	11.98	0.9784	13.39	16.48	0.9730	17.28	21.11
0.9837	9.78	12.06	0.9783	13.46	16.57	0.9729	17.35	21.20
0.9836	9.85	12.14	0.9782	13.53	16.65	0.9728	17.42	21.28
0.9835	9.92	12.23	0.9781	13.60	16.74	0.9727	17.49	21.37
0.9834	9.99	12.31	0.9780	13.67	16.82	0.9726	17.56	21.45
0.9833	10.06	12.39	0.9779	13.74	16.91	0.9725	17.63	21.54
0.9832	10.12	12.47	0.9778	13.82	16.99	0.9724	17.70	21.62
0.9831	10.19	12.55	0.9777	13.89	17.08	0.9723	17.77	21.71
0.9830	10.26	12.63	0.9776	13.96	17.16	0.9722	17.84	21.79
0.9829	10.33	12.71	0.9775	14.03	17.25	0.9721	17.81	21.88
0.9828	10.40	12.79	0.9774	14.11	17.33	0.9720	17.98	21.96
0.9827	10.46	12.87	0.9773	14.18	17.42	0.9719	18.05	22.05
0.9826	10.53	12.95	0.9772	14.25	17.50	0.9718	18.12	22.13
0.9825	10.60	13.04	0.9771	14.32	17.59	0.9717	18.19	22.22
0.9824	10.67	13.12	0.9770	14.40	17.68	0.9716	18.26	22.30
0.9823	10.74	13.20	0.9769	14.47	17.76	0.9715	18.33	22.39
0.9822	10.80	13.28	0.9768	14.54	17.85	0.9714	18.40	22.47
0.9821	10.87	13.36	0.9767	14.61	17.93	0.9713	18.47	22.56
0.9820	10.94	13.44	0.9766	14.69	18.02	0.9712	18.54	22.64
0.9819	11.01	13.52	0.9765	14.76	18.10	0.9711	18.61	22.73
0.9818	11.07	13.61	0.9764	14.83	18.19	0.9710	18.68	22.82
0.9817	11.14	13.69	0.9763	14.90	18.27	0.9709	18.75	22.90
0.9816	11.21	13.78	0.9762	14.98	18.36	0.9708	18.82	22.99
0.9815	11.27	13.86	0.9761	15.05	18.44	0.9707	18.89	23.07
0.9814	11.34	13.94	0.9760	15.12	18.53	0.9706	18.96	23.16
0.9813	11.41	14.03	0.9759	15.19	18.62	0.9705	19.03	23.24
0.9812	11.47	14.11	0.9758	15.27	18 70	0.9704	19.10	23.33
0.9811	11.54	14.20	0.9757	15.34	18.79	0.9703	19.17	23.41
0.9810	11.61	14.28	0.9756	15.41	18.88	0.9702	19.24	23.50
0.9809	11.67	14.36	0.9755	15.49	18.96	0.9701	19.31	23.58
0.9808	11.74	14.45	0.9754	15.56	19.05	0.9700	19.38	23.67
0.9807	11.80	14.53	0.9753	15.63	19.14	0.9699	19.45	23.75
0.9806	11.87	14.62	0.9752	15.70	19.22	0.9698	19.52	23.84
0.9805	11.94	14.70	0.9751	15.78	19.31	0.9697	19.59	23.92
0.9804	12.00	14.78	0.9750	15.95	19.40	0.9696	19.66	24.00
0.9803	12.07	14.87	0.9749	15.92	19.48	0.9695	19.73	24.09
0.9802	12.14	14.95	0.9748	16.00	19.56	0.9694	19.80	24.17
0.9801	12.20	15.04	0.9747	16.07	19.65	0.9693	19.87	24.25
0.9800	12.27	15.12	0.9746	16.14	19.74	0.9692	19.94	24.34
0.9799	12.34	15.21	0.9745	16.22	19.83	0.9691	20.01	24.42
0.9798	12.41	15.29	0.9744	16.29	19.91	0.9690	20.09	24.51
0.9797	12.48	15.38	0.9743	16.36	20.00	0.9689	20.16	24.59

METHYL ALCOHOL (Continued)

Specific Gravity of Mixtures of Methyl Alcohol and Water by Volume and by Weight

Specific gravity	Per cent alcohol by wt.	Per cent alcohol by vol.	Specific gravity	Per cent alcohol by wt.	Per cent alcohol by vol.	Specific gravity	Per cent alcohol by wt.	Per cent alcohol by vol.
0.9688	20.23	24.67	0.9668	21.63	26.35	0.9648	23.03	27.9
0.9687	20.30	24.76	0.9667	21.70	26.43	0.9647	23.10	28.0
0.9686	20.37	24.84	0.9666	21.77	26.52	0.9646	23.17	28.1
0.9685	20.44	24.92	0.9665	21.84	26.60	0.9645	23.24	28.2
0.9684	20.51	25.01	0.9664	21.91	26.68	0.9644	23.31	28.3
0.9683	20.58	25.09	0.9663	21.98	26.77	0.9643	23.38	28.4
0.9682	20.65	25.17	0.9662	22.05	26.85	0.9642	23.45	28.4
0.9681	20.72	25.26	0.9661	22.12	26.94	0.9641	23.52	28.5
0.9680	20.79	25.34	0.9660	22.19	27.02	0.9640	23.59	28.6
0.9679	20.86	25.42	0.9659	22.26	27.10	0.9639	23.66	28.7
0.9678	20.93	25.51	0.9658	22.52	27.18	0.9638	23.75	28.8
0.9677	21.00	25.59	0.9657	22.40	27.26	0.9637	23.80	28.8
0.9676	21.07	25.68	0.9656	22.47	27.34	0.9636	23.88	28.9
0.9675	21.14	25.76	0.9655	22.54	27.43	0.9635	23.95	29.0
0.9674	21.21	25.84	0.9654	22.61	27.51	0.9634	24.02	29.1
0.9673	21.28	25.95	0.9653	22.68	27.59	0.9633	24.09	29.1
0.9672	21.33	26.01	0.9652	22.75	27.67	0.9632	24.16	29.2
0.9671	21.42	26.10	0.9651	22.82	27.75	0.9631	24.23	29.3
0.9670	21.49	26.18	0.9650	22.89	27.83	0.9630	24.31	29.4
0.9669	21.56	26.26	0.9649	22.96	27.91	0.9629	24.38	29.5

MMERSION REFRACTOMETER READINGS OF METHYL AND ETHYL ALCOHOLS AT 20°C

By Leach and Lythgoe. Jour. Am. Chem. Soc. 27, 964 (1905)

% Alcohol by Weight	Methyl Alcohol	Ethyl Alcohol	% Alcohol by Weight	Methyl Alcohol	Ethyl Alcohol	% Alcohol by Weight	Methyl Alcohol	Ethyl Alcohol
0	14.5	14.5	35	35.8	75.8	70	33.0	100.0
1	14.8	16.0	36	36.3	76.9	71	32.3	100.2
2	15.4	17.6	37	36.8	78.0	72	31.7	100.4
3	16.0	19.1	38	37.3	79.1	73	31.1	100.6
4	16.6	20.7	39	37.7	80.2	74	30.4	100.8
5	17.2	22.3	40	38.1	81.3	75	29.7	101.0
6	17.8	24.1	41	38.4	82.3	76	29.0	101.0
7	18.4	25.9	42	38.8	83.3	77	28.3	100.9
8	19.0	27.8	43	39.2	84.2	78	27.6	100.9
9	19.6	29.6	44	39.3	85.2	79	26.8	100.8
10	20.2	31.4	45	39.4	86.2	80	26.0	100.7
11	20.8	33.2	46	39.5	87.0	81	25.1	100.6
12	21.4	35.0	47	39.6	87.8	82	24.3	100.5
13	22.0	36.9	48	39.7	88.7	83	23.6	100.4
14	22.6	38.7	49	39.8	89.5	84	22.8	100.3
15	23.2	40.5	50	39.8	90.3	85	21.8	100.1
16	23.9	42.5	51	39.7	91.1	86	20.8	99.8
17	24.5	44.5	52	39.6	91.8	87	19.7	99.5
18	25.2	46.5	53	39.6	92.4	88	18.6	99.2
19	25.8	48.5	54	39.5	93.0	89	17.3	98.9
20	26.5	50.5	55	39.4	93.6	90	16.1	98.6
21	27.1	52.4	56	39.2	94.1	91	14.9	98.3
22	27.8	54.3	57	39.0	94.7	92	13.7	97.8
23	28.4	56.3	58	38.6	95.2	93	12.4	97.2
24	29.1	58.2	59	38.3	95.7	94	11.0	96.4
25	29.7	60.1	60	37.9	96.2	95	9.6	95.7
26	30.3	61.9	61	37.5	96.7	96	8.2	94.9
27	30.9	63.7	62	37.0	97.1	97	6.7	94.0
28	31.6	65.5	63	36.5	97.5	98	5.1	93.0
29	32.2	67.2	64	36.0	98.0	99	3.5	92.0
30	32.8	69.0	65	35.5	98.3	100	2.0	91.0
31	33.5	70.4	66	35.0	98.7			
32	34.1	71.7	67	34.5	99.1			
33	34.7	73.1	68	34.0	99.4			
34	35.2	74.4	69	33.5	99.7			

Calculation of the percentage of ethyl and methyl alcohols in a mixture with ater, assuming a distillate to have a sp. gr. of 0.97917 $\frac{15.56°}{15.56°}$ and a refraction 30.0 at 20° on the immersion refractometer. — From the tables of sp. gr. for ese alcohols the density is found to correspond to 13.70% and 12.83% by ight of ethyl and methyl alcohol respectively; from the table above, the fractometer readings corresponding to 13.70% ethyl and methyl alcohol are .16 and 22.42 respectively. Then $(38.16 - 30.0) / (38.16 - 22.42) \times 0 = 51.8\%$, or 51.8% of the alcohol in the distillate is methyl alcohol.

$(12.83 \times 0.518) + 13.70 \times (1 - 0.518) = 13.25$ which is the % by ight of the mixed alcohols in the distillate, of which 13.25×0.518 or 86% is methyl alcohol and $13.25 \times (1 - 0.518)$ or 6.39% is ethyl alcohol.

SPECIFIC GRAVITY OF GASES AND VAPORS

Name	Formula	Mol. wt.	Mass of 1 liter in g. 760mm. 0° C.	Density, air = 1		Density, O =	
				Observed	Computed	Observed	Theoret.
Acetylene	C_2H_2	26.02	1.1708	0.9056	0.9056	0.8193	0.813
Air	.....	.....	1.2928	.....	1.0000	.....	
Ammonia	NH_3	17.03	0.7708	0.5962	0.5963	0.5394	0.532
Argon	A	39.91	1.7828	1.379	1.378	1.248	1.247
Bromine	Br_2	159.83	7.1388	5.524	5.524		
Butane	C_4H_{10}	58.08	2.5985	2.01	.....	1.82	1.815
Carbon dioxide	CO_2	44.	1.9768	1.5288	1.5289	1.3832	1.376
monoxide	CO	28.	1.2501	0.9670	0.9670	0.8749	0.875
oxychloride	$COCl_2$	98.91	4.5313	3.505	.....	3.171	3.091
oxysulphide	COS	60.06	2.7201	2.104	.....	1.904	1.878
Chlorine	Cl_2	70.91	3.2204	2.491	2.4906	2.254	2.216
monoxide	Cl_2O	86.91	3.8874	3.007	.....	2.72	2.716
Cyanogen	C_2N_2	52.02	2.3348	1.806	1.8353	1.634	1.625
Ethane	C_2H_6	30.05	1.3567	1.0494	1.0496	0.9494	0.939
Ethyl chloride	C_2H_5Cl	64.50	2.8700	2.22	2.257	2.01	2.015
Ethylene	C_2H_4	28.03	1.2644	0.978	0.9753	0.885	0.876
Fluorine	F_2	38.	1.6354	1.265	.....	1.145	1.187
Helium	He	4.00	0.1769	0.1368	.....	0.1238	0.125
Hydrochloric acid	HCl	36.47	1.6394	1.2681	1.2683	1.1473	1.139
Hydrofluoric acid	HF	20.01	0.9218	0.713	.....	0.645	0.625
Hydriodic acid	HI	127.94	5.7245	4.428	.....	4.01	4.029
Hydrogen	H_2	2.016	0.08982	0.06948	0.06949	0.06286	0.062
selenide	H_2Se	81.22	3.6134	2.795	2.850	2.529	2.538
sulphide	H_2S	34.08	1.5392	1.1895	1.1773		
telluride	H_2Te	129.52	5.8034	4.489	.....	4.062	4.066
Krypton	Kr	82.90	3.6431	2.818	2.832	2.550	2.556
Methane	CH_4	16.03	0.7167	0.5544	0.5544	0.5016	0.501
Methyl Chloride	CH_3Cl	50.48	2.3044	1.7825	1.785	1.6127	1.578
Neon	Ne_2	20.40	0.8713	0.674	.....	0.610	0.625
Nitric oxide	NO	30.01	1.3401	1.0366	1.0366	0.9397	0.939
Nitrogen	N_2	28.02	1.2507	0.9673	0.9682	0.8752	
Nitrous oxide	N_2O	44.02	1.9781	1.5301	1.5303	1.3844	1.373
Nitrosyl chloride	NOCl	65.47	2.9864	2.31	.....	2.09	2.046
Oxygen	O_2	32.	1.4289	1.1053	1.1053	1.000	1.000
Phosphine	PH_3	34.05	1.5293	1.1829	1.1830	1.0702	1.064
Silicon fluoride	SiF_4	104.06	4.6541	3.60	.....	3.26	3.259
Sulphur dioxide	SO_2	64.06	2.9268	2.2639	2.2638	2.0482	2.003
Xenon	X	130.2	5.7168	4.422	4.506	4.001	4.00

PROPERTIES OF MATTER

DENSITY OF ELEMENTS

The density is given in grams per cubic centimeter and pounds per cubic foot at the temperature stated. Where no temperature is given ordinary atmospheric temperature is understood.

Element	Temp. °C.	Density gm./c.c.	Lbs. per cu. ft.	Observer
luminum, hard drawn	20	2.699	168.5	Edwards, 1925
liquid	659	2.382	148.7	Moorman, 1921
ntimony, vacuo-distilled	20	6.618	413.1	Kahlbaum, 1902
compressed	20	6.691	417.7	Kahlbaum, 1902
amorphous	.....	6.22	388.3	Herard
rgon, liquid	−183	1.3845	86.4	Baly-Donnan
	−189	1.4233	88.9	Baly-Donnan
rsenic, metallic	15	5.73	357.7	Lashchenko, 1922
amorphous, brown—black	.....	3.70	231.0	Guenther [1908
yellow	18	2.0	124.9	Erdmann & Reppert,
arium	.....	3.78	236.0	Guntz
	25	3.5	218.5	Biltz & Hüttig, 1920
ismuth, electrolytic	.....	9.747	608.5	Classen, 1890 [1912
	20	9.80	611.8	Johnston & Adams,
vacuo-distilled	20	9.781	610.6	Kahlbaum, 1902
liquid	271	10.00	624.3	Vincentini-Omodei
	271	10.24	639.25	Plüss, 1915
solid	271	9.67	603.7	Vincentini-Omodei
oron, crystal	.....	2.535	158.3	Wigand
amorphous	.....	2.45	152.9	Moissan
romine, liquid	.....	3.12	194.8	Richards-Stull
admium, cast	20	8.648	539.9	Egerton & Lee, 1923
wrought	.....	8.67	541.2	
vacuo-distilled	20	8.648	539.9	Kahlbaum, 1902
solid	318	8.37	522.5	Vincentini-Omodei
liquid	318	7.99	498.8	Vincentini-Omodei
	349	7.94	495.7	Arpi, 1914
aesium	20	1.873	116.9	Richards-Brink
	.....	1.54	96.1	Brink
alcium	.....	3.52	219.7	Wigand
arbon, crystal	.....	2.25	140.5	Wigand
graphite	.....	6.79	423.9	Muthmann-Weiss
erium, electrolytic	.....	6.9	430.7	Muthmann-Weiss
pure	.....	1.507	94.1	Drugman-Ramsay
hlorine, liquid	−33.6	6.52–73	407.0–420.1	
hromium	.....	6.92	432.0	Moissan
pure	20	7.1	443.2	Richards, 1907
	.....	8.71	543.7	Tilden [1915
obalt	21	8.9	555.6	Kalmus & Harper,
	.....	8.4	524.4	Muthmann-Weiss
olumbium	15	8.30–95	518.1–558.7	
opper, cast	.....	8.89	555.0	Dellinger, 1911
annealed	20	8.85–95	552.5–558.7	
wrought	.....	8.89	555.0	Dellinger, 1911
hard-drawn	20	8.9326	557.6	Kahlbaum, 1902
acuo-distilled	20	8.9376	558.0	Kahlbaum, 1902
compressed	20			

DENSITY OF ELEMENTS (Continued)

Element	Temp. °C.	Density gm./c.c.	Lbs. per cu. ft.	Observer
liquid	.....	8.217	513.0	Roberts-Wrightson
Erbium	.....	4.77	298.0	St. Meyer
Fluorine, liquid	−200	1.14	71.2	Moissan-Dewar
Gallium	23	5.93	370.2	de Boisbaudran
Germanium	20	5.46	340.9	Winkler [19
Glucinum (Beryllium)	20	1.84	114.9	Fichter & Jablczynsk
Gold, cast	.....	19.3	1204.8	
cold rolled	20	19.296	1204.6	Rose, 1912
wrought	.....	19.33	1206.7	[19
drawn annealed	20	19.26	1202.3	Kahlbaum & Sturi
vacuo-distilled	20	18.88	1178.6	Kahlbaum, 1902
compressed	20	19.27	1203.0	Kahlbaum, 1902
Helium, liquid	−269	0.15	9.4	Onnes
Hydrogen, liquid	−252	0.07	4.4	Dewar, 1904
Indium	.....	7.28	454.5	Richards
Iridium	17	22.42	1399.6	Deville-Debray
Iodine	20	4.94	308.4	Richards-Stull
Iron, pure	.....	7.85–88	490.1–491.9	[19
electrolytic, rolled	20	7.90	493.2	Tritton & Hanso
gray cast	.....	7.03–13	438.9–445.1	
white cast	.....	7.58–73	473.2–482.6	
wrought	.....	7.80–90	486.9–493.2	
liquid	.....	6.88	429.5	Roberts-Austen
steel	.....	7.60–80	474.4–486.9	
Krypton, liquid	−146	2.16	134.8	Ramsay-Travers
Lanthanum	.....	6.15	383.9	Muthmann-Weiss
Lead, vacuo-distilled	20	11.342	708.0	Kahlbaum, 1902
compressed	20	11.347	708.4	Kahlbaum, 1902
solid	325	11.005	687.0	Vincentini-Omodei
liquid	325	10.645	664.5	Vincentini-Omodei
	400	10.597	661.5	Day, Sosman, 19
	850	10.078	629.1	Day, Sosman, 19
Lithium	20	0.534	33.3	Richards-Brink, 19
Magnesium	.....	1.741	108.7	Voigt
Manganese	.....	7.42	463.2	Prelinger
Mercury, liquid	0	13.596	848.8	Regnault, Volkma
	20	13.546	845.6	
	−38.8	13.690	854.6	Vincentini-Omodei
solid	−38.8	14.193	886.0	Vincentini-Omodei
	−188	14.383	897.9	Dewar, 1902
Molybdenum	.....	9.01	562.5	Moissan
	.....	10.2	636.8	Fink, 1910
Neodymium	.....	6.96	434.5	Muthmann-Weiss
Nickel	.....	8.60–90	536.9–555.6	
Nitrogen, liquid	−195	0.81	50.6	Baly-Donnan, 190
	−205	0.854	53.3	Baly-Donnan, 190
Osmium	.....	22.5	1404.6	Deville-Debray
Oxygen, liquid	−184	1.14	71.2	
Palladium	.....	12.16	759.1	Richards-Stull
Phosphorus, white	.....	1.83	114.2	
red	.....	2.20	137.3	
metallic	15	2.34	146.1	Hittorf
Platinum	20	21.37	1334.1	Richards-Stull
Potassium	20	0.87	54.3	Richards-Brink, 19
solid	62.1	0.851	53.1	Vincentini-Omodei
liquid	62.1	0.83	51.8	Vincentini-Omodei
Praesodymium	.....	6.475	404.2	Muthmann-Weiss
Rhodium	.....	12.44	776.6	Holborn-Henning
Rubidium	20	1.532	95.6	Richards-Brink, 19
Ruthenium	0	12.06	752.9	Toby
Samarium	.....	7.7–8	480.7–486.9	Muthmann-Weiss

DENSITY OF ELEMENTS (Continued)

Element	Temp. °C.	Density gm./c.c.	Lbs. per cu. ft.	Observer
Selenium	.....	4.3–8	268.4–299.6	
Silicon, crystal	20	2.42	151.1	Richards-Stull-Brink
amorphous	15	2.35	146.7	Vigoroux
Silver, cast	.....	10.42–53	650.5–657.4	
wrought	.....	10.6	661.7	
vacuo-distilled	20	10.492	655.0	Kahlbaum, 1902
compressed	20	10.503	655.7	Kahlbaum, 1902
liquid	.....	9.51	593.7	Wrightson
Sodium	20	0.9712	60.6	Richards-Brink, 1907
solid	97.6	0.9519	59.4	Vincentini-Omodei
liquid	97.6	0.9287	58.0	Vincentini-Omodei
solid	−188	1.0066	62.8	Dewar
Strontium	.....	2.50–58	156.1–161.1	Matthiessen
Sulfur	.....	2.0–1	124.9–131.1	
liquid	.....	1.811	112.1	Vincentini-Omodei
Tantalum	.....	16.6	1036.3	
Tellurium, crystal	.....	6.25	390.2	
amorphous	20	6.02	375.8	Beljankin
Thallium	.....	11.86	740.4	Richards-Stull [1925
Thorium	.....	11.3–11.7	705.4–730.4	Rentschler, Marden,
Tin, white cast	.....	7.29	455.1	Matthiessen
wrought	.....	7.30	455.7	
crystallized	.....	6.97–7.18	435.1–448.2	
solid	226	7.184	448.5	Vincentini-Omodei
liquid	226	6.99	436.4	Vincentini-Omodei
gray	.....	5.8	362.1	
Titanium	18	4.5	280.9	Mixter
Tungsten	.....	18.6–19.1	1161.1–1192.4	
Uranium	13	18.7	1167.4	Zimmermann
Vanadium	.....	5.69	355.3	Ruff-Martin
	20	5.96	372.1	Hull, 1922
Xenon, liquid	−109	3.52	219.7	Ramsay-Travers
Yttrium	.....	3.80	237.2	St. Meyer
Zinc, cast	.....	7.04–16	439.5–447.0	
wrought	.....	7.19	448.9	
vacuo-distilled	20	6.92	432.0	Kahlbaum, 1902
compressed	20	7.13	445.1	Kahlbaum, 1902
liquid	.....	6.48	404.5	Roberts-Wrightson
Zirconium	.....	6.44	402.0	

DENSITY OF ALLOYS

The density is given in grams per cubic centimeter at ordinary atmospheric temperatures.

Alloy.	Composition.	g./cm.³	Pounds per cu. ft.
Aluminum and copper	10 Al, 90 Cu	7.69	480.06
	5 Al, 95 Cu	8.37	522.51
	3 Al, 97 Cu	8.69	542.49
Aluminum and zinc	91 Al, 9 Zn	2.80	174.80
Bell metal	78 Cu, 22 Zn	8.70	543.11
Bismuth, lead and tin	53 Bi, 40 Pb, 7 Sn	10.56	659.23

DENSITY OF ALLOYS (Continued)

Alloy.	Composition.	g/cm.³	Pounds per cu. ft
Brass, yellow	70 Cu, 30 Zn cast	8.44	526.8
	rolled	8.56	534.3
	drawn	8.70	543.1
red	90 Cu, 10 Zn	8.60	536.8
white	50 Cu, 50 Zn	8.20	511.0
Bronze	90 Cu, 10 Sn(gun metal)	8.78	548.1
	85 Cu, 15 Sn	8.89	554.9
	80 Cu, 20 Sn	8.74	545.6
	75 Cu, 25 Sn	8.83	551.2
Cadmium and tin	32 Cd, 68 Sn	7.70	480.6
Constantan	60 Cu, 40 Ni	8.88	554.3
German silver	26.3 Cu, 36.6 Zn, 36.8 Ni	8.30	518.1
	52 Cu, 26 Zn, 22 Ni	8.45	527.5
	59 Cu, 30 Zn, 11 Ni	8.34	520.6
	63 Cu, 30 Zn, 6 Ni	8.30	518.1
Gold and copper	98 Au, 2 Cu	18.84	1176.1
	96 Au, 4 Cu	18.36	1146.1
	94 Au, 6 Cu	17.95	1120.5
	92 Au, 8 Cu	17.52	1093.7
	90 Au, 10 Cu	17.16	1071.2
	88 Au, 12 Cu	16.81	1049.4
	86 Au, 14 Cu	16.47	1028.1
Invar	63.8 Fe, 36 Ni, 0.2 C	8.00	499.4
Lead and tin	87.5 Pb, 12.5 Sn	10.60	661.7
	84 Pb, 16 Sn	10.33	644.8
	77.8 Pb, 22.2 Sn	10.05	627.3
	63.7 Pb, 36.3 Sn	9.43	588.6
	46.7 Pb, 53.3 Sn	8.73	544.9
	30.5 Pb, 69.5 Sn	8.24	514.4
Magnalium	90 Al, 10 Mg	2.50	156.0
	70 Al, 30 Mg	2.00	124.8
Manganese bronze	95 Cu, 5 Mn	8.80	549.3
Manganin	84 Cu, 12 Mn, 4 Ni	8.50	530.5
Monel metal	71 Ni, 27 Cu, 2 Fe	8.90	555.5
Nickelin	.....	8.77	547.4
Phosphor bronze	79.7 Cu, 10 Sn, 9.5 Sb, 0.8 P	8.80	549.3
Platinum and iridium	90 Pt, 10 Ir	21.62	1349.4
	85 Pt, 15 Ir	21.62	1349.4
	66.67 Pt, 33.33 Ir	21.87	1365.0
	5 Pt, 95 Ir	22.38	1397.2
Speculum metal	67 Cu, 33 Sn	8.60	536.9
Steel	99 Fe, 1 C	7.83	488.8
manganese	86 Fe, 13 Mn, 1 C	7.81	487.6
Wood's metal	50 Bi, 25 Pb, 12.5 Cd, 12.5 Sn	10.56	659.2

DENSITY OF VARIOUS SOLIDS

The approximate density of various solids at ordinary atmospheric temperature.

(Selected principally from the Smithsonian Tables.)

Substance.	Grams per cu. cm.	Pounds per cu. ft.
Agate	2.5–2.7	156–168
Alabaster, carbonate	2.69–2.78	168–173
sulphate	2.26–2.32	141–245
Albite	2.62–2.65	163–165
Amber	1.06–1.11	66–69
Amphoboles	2.9–3.2	180–200
Anorthite	2.74–2.76	171–172
Asbestos	2.0–2.8	125–175
Asphalt	1.1–1.5	69–94
Basalt	2.4–3.1	150–190
Beeswax	0.96–0.97	60–61
Beryl	2.69–2.7	168
Biotite	2.7–3.1	170–190
Bone	1.7–2.0	106–125
Brick	1.4–2.2	87–137
Butter	0.86–0.87	53–54
Calamine	4.1–4.5	255–280
Calcspar	2.6–2.8	162–175
Caoutchouc	0.92–0.99	57–62
Celluloid	1.4	87
Cement, set	2.7–3.0	170–190
Chalk	1.9–2.8	118–175
Charcoal, oak	0.57	35
pine	0.28–0.44	18–28
Cinnabar	8.12	507
Clay	1.8–2.6	122–162
Coal, anthracite	1.4–1.8	87–112
bituminous	1.2–1.5	75–94
Cocoa butter	0.89–0.91	56–57
Coke	1.0–1.7	62–165
Copal	1.04–1.14	65–71
Cork	0.22–0.26	14–16
Corundum	3.9–4.0	245–250
Diamond	3.01–3.52	188–220
Dolomite	2.84	177
Ebonite	1.15	72
Emery	4.0	250
Epidote	3.25–3.50	203–218
Feldspar	2.55–2.75	159–172
Flint	2.63	164
Fluorite	3.18	198
Galena	7.3–7.6	460–470
Gamboge	1.2	75
Garnet	3.15–4.3	197–268
Gas carbon	1.88	117
Gelatine	1.27	80
Glass, common	2.4–2.8	150–175
flint	2.9–5.9	180–370
Glue	1.27	80
Granite	2.64–2.76	165–172
Graphite	2.30–2.72	144–170
Gum arabic	1.3–1.4	80–85
Gypsum	2.31–2.33	144–145
Hematite	4.9–5.3	306–330
Hornblende	3.0	187
Ice	0.917	57.2
India rubber	0.91–0.93	57–58
Ivory	1.83–1.92	114–120
Leather, dry	0.86	54
Lime, slaked	1.3–1.4	81–87
Limestone	2.68–2.76	167–171
Magnetite	4.9–5.2	306–324
Malachite	3.7–4.1	231–256
Marble	2.6–2.8	160–177
Meerschaum	0.99–1.28	62–80
Mica	2 6–3.2	165–200
Muscovite	2.76–3.00	172–225
Ochre	3.5	218
Opal	2.2	137
Paper	0.7–1.15	44–72
Paraffin	0.87–0.91	54–57
Peat	0 84	52
Pitch	1 07	67
Porcelain	2 3–2.5	143–156
Porphyry	2.6–2.9	162–181
Pyrite	4.95–5.1	309–318
Quartz	2.65	165
Resin	1.07	67
Rock salt	2.18	136
Sandstone	2.14–2.36	134–147
Serpentine	2.50–2.65	156–165
Silica, fused transparent	2.21	142
translucent	2.07	133
Slag	2.0–3.9	125–240
Slate	2.6–3.3	162–205
Soapstone	2.6–2.8	162–175
Starch	1.53	95
Sugar	1.61	100
Talc	2.7 2.8	168–174
Tallow	0.9 –0.97	57–60
Tar	1.0	66
Topaz	3.5–3 6	219–223

DENSITY OF VARIOUS SOLIDS (Continued)

Substance.	Grams per cu. cm.	Pounds per cu. ft.	Substance.	Grams per cu. cm.	Pounds per cu. ft.
Tourmaline	3.0–3.2	190–200	lignum vitæ	1.17–1.33	73–83
Wax, sealing	1.8	117	locust	0.67–0.71	42–44
Wood (seasoned)			logwood	0.91	57
alder	0.42–0.68	26–42	mahogany		
apple	0.66–0.84	41–52	Honduras	0.66	41
ash	0.65–0.85	40–53	Spanish	0.85	53
bamboo	0.31–0.40	19–25	maple	0.62–0.75	39–47
basswood	0.32–0.59	20–37	oak	0.60–0.90	37–56
beech	0.70–0.90	43–56	pear	0.61–0.73	38–45
blue gum	1.00	62	pine, pitch	0.83–0.85	52–53
birch	0.51–0.77	32–48	white	0.35–0.50	22–31
box	0.95–1.16	59–72	yellow	0.37–0.60	23–37
butternut	0.38	24	plum	0.66–0.78	41–49
cedar	0.49–0.57	30–35	poplar	0.35–0.50	22–31
cherry	0.70–0.90	43–56	satinwood	0.95	59
dogwood	0.76	47	spruce	0.48–0.70	30–44
ebony	1.11–1.33	69–83	sycamore	0.40–0.60	24–37
elm	0.54–0.60	34–37	teak, Indian	0.66–0.88	41–55
hickory	0.60–0.93	37–47	African	0.98	61
holly	0.76	47	walnut	0.64–0.70	40–43
juniper	0.56	35	water gum	1.00	62
larch	0.50–0.56	31–35	willow	0.40–0.60	24–37

For the specific gravity of *alloys* see Composition and Physical Properties of Alloys.

For the specific gravity of the *elements* see Physical Constants of the Elements.

For specific gravity of *inorganic compounds* see Physical Constants of Inorganic Compounds.

For specific gravity of *organic compounds* see Physical Constants of Organic Compounds.

For specific gravity of *minerals* see Physical Constants of Common Minerals.

DENSITY OF WATER

The temperature of maximum density for pure water, free from air = 3°.98 C.

The density at this temperature = **0.999973** (C. G. S.).

(International Bureau of Weights and Measures, 1910.)

DENSITY OF VARIOUS LIQUIDS

(Selected from Smithsonian Tables.)

Liquid.	Grams per cu.cm.	Pounds per cu.ft.	Temp. °C.
Acetone	0.792	49.4	0°
Alcohol, ethyl	0.791	49.4	0
methyl	0.810	50.5	0
Benzene	0.899	56.1	0
Carbolic acid	0.950–0.965	59.2–60.2	15
Chloroform	1.480	92.3	18
Ether	0.736	45.9	0
Gasoline	0.66–0.69	41.0–43.0	..
Glycerine	1.260	78.6	0
Milk	1.028–1.035	64.2–64.6	..
Naphtha, wood	0.848–0.810	52.9–50.5	0
Naphtha, petroleum ether	0.665	41.5	15
Oils:			
castor	0.969	60.5	15
cocoanut	0.925	57.7	15
cotton seed	0.926	60.2	16
creosote	1.040–1.100	64.9–68.6	15
linseed, boiled	0.942	58.8	15
olive	0.918	57.3	15
turpentine	0.873	54.2	16
Sea water	1.025	64.0	15

DENSITY OF ALCOHOL

DENSITY OF ETHYL ALCOHOL IN GRAMS PER CUBIC CENTIMETER, COMPUTED FROM MENDELEJEFF'S FORMULA

(Selected from Smithsonian Tables.)

Temp. °C.	0	1	2	3	4
0	.80625	.80541	.80457	.80374	.80290
10	.79788	.79704	.79620	.79535	.79451
20	.78945	.78860	.78775	.78691	.78606
30	.78097	.78012	.77927	.77841	.77756

Temp. °C.	5	6	7	8	9
0	.80207	.80123	.80039	.79956	.79872
10	.79367	.79283	.79198	.79114	.79029
20	.78522	.78437	.78352	.78267	.78182
30	.77671	.77585	.77500	.77414	.77329

HYDROMETERS AND DENSITY UNITS

Alcoholometer. — For testing alcoholic solutions; the scale shows the per cent of alcohol by volume; 0°–100° is the per cent.

Ammoniameter. — For testing ammonia solutions; scale 0°–40°; to convert to sp. gr. multiply by 3 and deduct from 1000.

Barktrometer or *Barkometer.* — For testing tanning liquor; scale 0°–80° Bk; the number to the right of the decimal point of the sp. gr. is the degree Bk; thus, 1.025 sp. gr. is 25° Bk.

Baumé. — There are two kinds in use; heavy Bé, for liquids heavier than water and light Bé for liquids lighter than water. In the former, 0° corresponds to a sp. gr. 1.000 (water at 4°C.) and 66° corresponds to a sp. gr. 1.842; in the lighter than water scale, 0° Bé is equivalent to the gravity of a 10% solution of sodium chloride and 60° Bé corresponds to a sp. gr. of 0.745. For Baumé degrees on the scale of densities greater than unity, the following equation gives the means of conversion:

$$\text{Sp. gr.} = \frac{m}{m - d}$$

where m = 145 (in the United States)
m = 144 (old scale used in Holland)
m = 146.78 (New scale or Gerlach scale)
d = Baumé reading

Beck's Hydrometer has 0° corresponding to sp. gr. 1.000 and 30° to sp. gr. 0.850; equal divisions on the scale are continued as far as required in both directions.

Brix Saccharometer or *Balling Saccharometer* shows directly the per cent of sugar (sucrose) by weight at the temperature indicated on the instrument, usually 17.5°C.; i.e., degrees Brix is the per cent sugar.

Cartier's Hydrometer floats in water at the 10° scale division and at 30° corresponds to 32° Bé.

Oleometer. — For vegetable and sperm oils; scale 50°–0° corresponds to sp. gr. 0.870–0.970.

Soxhlet's Lactometer, for determining the density of milk, has a scale from 25° (sp. gr. 1.025) to 35° (sp. gr. 1.035) divided into suitable scale divisions.

Twaddell Hydrometers have the scale so arranged that the reading multiplied by 5 and added to 1000 gives the sp. gr. with reference to water as 1000; it is always used for densities greater than water.

HYDROMETER CONVERSION TABLES

SHOWING THE RELATION BETWEEN DENSITY (C. G. S.) AND DEGREES BAUMÉ FOR DENSITIES LESS THAN UNITY.

Density.	Degrees Baumé.				
	.00	.01	.02	.03	.04
0.60	103.33	99.51	95.81	92.22	88.75
.70	70.00	67.18	64.44	61.78	59.19
.80	45.00	42.84	40.73	38.68	36.67
.90	25.56	23.85	22.17	20.54	18.94
1.00	10.00	.....	.....	.....	.....

Density.	Degrees Baumé.				
	.05	.06	.07	.08	.09
0.60	85.38	82.12	78.95	75.88	72.90
.70	56.67	54.21	51.82	49.49	47.22
.80	34.71	32.79	30.92	29.09	27.30
.90	17.37	15.83	14.33	12.86	11.41
1.00	.....	.....	.....	.....	.....

HYDROMETER CONVERSION TABLES
(Continued)

SHOWING THE RELATION BETWEEN DENSITY (C. G. S.) AND THE BAUMÉ AND TWADDELL SCALES FOR DENSITIES ABOVE UNITY.

Density.	Degrees Baumé.	Degrees Twaddell.	Density.	Degrees Baumé.	Degrees Twaddell.
1.00	0.00	0	1.41	42.16	82
1.01	1.44	2	1.42	42.89	84
1.02	2.84	4	1.43	43.60	86
1.03	4.22	6	1.44	44.31	88
1.04	5.58	8	1.45	45.00	90
1.05	6.91	10	1.46	45.68	92
1.06	8.21	12	1.47	46.36	94
1.07	9.49	14	1.48	47.03	96
1.08	10.74	16	1.49	47.68	98
1.09	11.97	18	1.50	48.33	100
1.10	13.18	20	1.51	48.97	102
1.11	14.37	22	1.52	49.60	104
1.12	15.54	24	1.53	50.23	106
1.13	16.68	26	1.54	50.84	108
1.14	17.81	28	1.55	51.45	110
1.15	18.91	30	1.56	52.05	112
1.16	20.00	32	1.57	52.64	114
1.17	21.07	34	1.58	53.23	116
1.18	22.12	36	1.59	53.80	118
1.19	23.15	38	1.60	54.38	120
1.20	24.17	40	1.61	54.94	122
1.21	25.16	42	1.62	55.49	124
1.22	26.15	44	1.63	56.04	126
1.23	27.11	46	1.64	56.58	128
1.24	28.06	48	1.65	57.12	130
1.25	29.00	50	1.66	57.65	132
1.26	29.92	52	1.67	58.17	134
1.27	30.83	54	1.68	58.69	136
1.28	31.72	56	1.69	59.20	138
1.29	32.60	58	1.70	59.71	140
1.30	33.46	60	1.71	60.20	142
1.31	34.31	62	1.72	60.70	144
1.32	35.15	64	1.73	61.18	146
1.33	35.98	66	1.74	61.67	148
1.34	36.79	68	1.75	62.14	150
1.35	37.59	70	1.76	62.61	152
1.36	38.38	72	1.77	63.08	154
1.37	39.16	74	1.78	63.54	156
1.38	39.93	76	1.79	63.99	158
1.39	40.68	78	1.80	64.44	160
1.40	41.42	80	....	.....	...

ABSOLUTE DENSITY OF WATER

DENSITY IN GRAMS PER CUBIC CENTIMETER, COMPUTED FROM THE RELATIVE VALUES BY THIESEN, SCHEEL AND DISSELHORST (1900), AND THE ABSOLUTE VALUE AT 3°.98 C. BY THE INTERNATIONAL BUREAU OF WEIGHTS AND MEASURES (1910).

Degrees	0	1	2	3	4	5	6	7	8	9
0	0.999841	847	854	860	866	872	878	884	889	895
1	900	905	909	914	918	923	927	930	934	938
2	941	944	947	950	953	955	958	960	962	964
3	965	967	968	969	970	971	972	972	973	973
4	973	973	973	972	972	972	970	969	968	966
5	965	963	961	959	957	955	952	950	947	944
6	941	938	935	931	927	924	920	916	911	907
7	902	898	893	888	883	877	872	866	861	855
8	849	843	837	830	824	817	810	803	796	789
9	781	774	766	758	751	742	734	726	717	709
10	700	691	682	673	664	654	645	635	625	615
11	605	595	585	574	564	553	542	531	520	509
12	498	486	475	463	451	439	427	415	402	390
13	377	364	352	339	326	312	299	285	272	258
14	244	230	216	202	188	173	159	144	129	114
15	099	084	069	054	038	023	007	*991	*975	*959
16	0.998943	926	910	893	877	860	843	826	809	792
17	774	757	739	722	704	686	668	650	632	613
18	595	576	558	539	520	501	482	463	444	424
19	405	385	365	345	325	305	285	265	244	224
20	203	183	162	141	120	099	078	056	035	013
21	0.997992	970	948	926	904	882	860	837	815	792
22	770	747	724	701	678	655	632	608	585	561
23	538	514	490	466	442	418	394	369	345	320
24	296	271	246	221	196	171	146	120	095	069
25	044	018	*992	*967	*941	*914	*888	*862	*836	*809
26	0.996783	756	729	703	676	649	621	594	567	540
27	512	485	457	429	401	373	345	317	289	261
28	232	204	175	147	118	089	060	031	002	*973
29	0.995944	914	885	855	826	796	766	736	706	676
30	646	616	586	555	525	494	464	433	402	371

RELATIVE DENSITY AND VOLUME OF WATER

The mass of one cubic centimeter of water at 4° C is taken as unity. The absolute density in C. G. S. units is obtained by multiplying the relative density by 0.999973.

(Smithsonian Tables, compiled from Various Authors.)

Temp. ° C.	Density.	Volume.	Temp. ° C.	Density.	Volume
−10	0.99815	1.00186	+35	0.99406	1.00598
−9	843	157	36	371	633
−8	869	131	37	336	669
−7	892	108	38	299	706
−6	912	088	39	262	743
−5	0.99930	1.00070	40	0.99224	1.00782
−4	945	055	41	186	821
−3	958	042	42	147	861
−2	970	031	43	107	901
−1	979	021	44	066	943
+0	0.99987	1.00013	45	0.99025	1.00985
1	993	007	46	0.98982	1.01028
2	997	003	47	940	072
3	999	001	48	896	116
4	1.00000	1.00000	49	852	162
5	0.99999	1.00001	50	0.98807	1.01207
6	997	003	51	762	254
7	993	007	52	715	301
8	988	012	53	669	349
9	981	019	54	621	398
10	0.99973	1.00027	55	0.98573	1.01448
11	963	037	60	324	705
12	952	048	65	059	979
13	940	060	70	0.97781	1.02270
14	927	073	75	489	576
15	0.99913	1.00087	80	0.97183	1.02899
16	897	103	85	0.96865	1.03237
17	880	120	90	534	590
18	862	138	95	192	959
19	843	157	100	0.95838	1.04343
20	0.99823	1.00177	110	0.9510	1.0515
21	802	198	120	0.9434	1.0601
22	780	221	130	0.9352	1.0693
23	756	244	140	0.9264	1.0794
24	732	268	150	0.9173	1.0902
25	0.99707	1.00294	160	0.9075	1.1019
26	681	320	170	0.8973	1.1145
27	654	347	180	0.8866	1.1279
28	626	375	190	0.8750	1.1429
29	597	405	200	0.8628	1.1590
30	0.99567	1.00435	210	0.850	1.177
31	537	466	220	0.837	1.195
32	505	497	230	0.823	1.215
33	473	530	240	0.809	1.236
34	440	563	250	0.794	1.259

DENSITY AND VOLUME OF MERCURY

BASED ON THE DENSITY OF MERCURY AT 0° C. BY THIESEN AND SCHEEL (1898)

(Selected from Smithsonian Tables.)

Temp. ° C.	Mass in gr. per cu.cm.	Vol. of 1 gr. in cu.cms.	Temp. ° C.	Mass in gr. per cu.cm.	Vol. in 1 gr. in cu.cms.
−10	13.6202	0.0734205	30°	13.5217	0.0739552
−9	6177	4338	31	5193	9686
−8	6152	4472	32	5168	9820
−7	6128	4606	33	5144	9953
−6	6103	4739	34	5119	40087
−5	13.6078	0.0734873	35	13.5095	0.0740221
−4	6053	5006	36	5070	0354
−3	6029	5140	37	5046	0488
−2	6004	5273	38	5021	0622
−1	5979	5407	39	4997	0756
0	13.5955	0.0735540	40	13.4973	0.0740891
1	5930	5674	50	4729	2229
2	5906	5808	60	4486	3569
3	5881	5941	70	4244	4910
4	5856	6075	80	4003	6252
5	13.5832	0.0736209	90	13.3762	0.0747594
6	5807	6342	100	3522	8939
7	5782	6476	110	3283	50285
8	5758	6610	120	3044	1633
9	5733	6744	130	2805	2982
10	13.5708	0.0736877	140	13.2567	0.0754334
11	5684	7011	150	2330	5688
12	5659	7145	160	2093	7044
13	5634	7278	170	1856	8402
14	5610	7412	180	1620	9764
15	13.5585	0.0737546	190	13.1384	0.0761128
16	5561	7680	200	1148	2495
17	5536	7813	210	0913	3865
18	5512	7947	220	0678	5239
19	5487	8081	230	0443	6616
20	13.5462	0.0738215	240	13.0209	0.0767996
21	5438	8348	250	12.9975	9381
22	5413	8482	260	9741	70769
23	5389	8616	270	9507	2161
24	5364	8750	280	9273	3558
25	13.5340	0.0738883	290	12.9039	0.0774958
26	5315	9017	300	8806	6364
27	5291	9151	310	8572	7774
28	5266	9285	320	8339	9189
29	5242	9419	330	8105	80609
30	13.5217	0.0739552	340	12.7872	0.0782033
			350	7638	3464
			360	7405	4900

DENSITY OF DRY AIR

AT THE TEMPERATURE t, AND UNDER THE PRESSURE H CM. OF MERCURY, THE DENSITY OF AIR

$$= \frac{0.001293 \cdot H}{1 + 0.00367\, t\ 76}$$

(From Miller's Laboratory Physics, Ginn & Co. publishers.)

t	Pressure H in Centimeters.						Proportional Parts.	
	72.0	73.0	74.0	75.0	76.0	77.0		
°							17	
10	0.001182	0.001198	0.001215	0.001231	0.001247	0.001264	cm.	
11	178	193	210	227	243	259	0.1	2
12	173	190	206	222	239	255	0 2	3
13	169	186	202	218	234	251	0.3	5
14	165	181	198	214	230	246	0.4	7
							0.5	8
							0.6	10
							0.7	12
15	0.001161	0.001177	0.001193	0.001210	0.001226	0.001242	0.8	14
16	157	173	189	205	221	238	0.9	15
17	153	169	185	201	217	233		
18	149	165	181	197	213	229	16	
19	145	161	177	193	209	225	cm.	
							0.1	2
							0.2	3
							0.3	5
20	0.001141	0.001157	0.001173	0.001189	0.001205	0.001221	0.4	6
21	137	153	169	185	201	216	0.5	8
22	134	149	165	181	197	212	0.6	10
23	130	145	161	177	193	208	0.7	11
24	126	142	157	173	189	204	0.8	13
							0.9	14
							15	
							cm.	
25	0.001122	0.001138	0.001153	0.001169	0.001185	0.001200	0.1	1
26	118	134	149	165	181	196	0.2	3
27	115	130	146	161	177	192	0.3	4
28	111	126	142	157	173	188	0.4	6
29	107	123	138	153	169	184	0.5	7
							0.6	9
							0.7	10
							0.8	12
30	0.001104	0.001119	0.001134	0.001150	0.001165	0.001180	0.9	13

DENSITY OF SATURATED VAPORS AT THE TEMPERATURE OF NORMAL EBULLITION

Vapor.	Temp. ° C.	Density.
Acetic acid	118.5	0.00315
Benzene	80.2	0.00275
Chloroform	61.2	0.00443
Ether	34.6	0.00311
Ethyl alcohol	78.3	0.00164
Methyl alcohol	64.7	0.00121
Water	100.0	0.000596

DENSITY OF GASES IN LIQUID AND SOLID FORM

Temperatures marked * are the temperatures of normal ebullition.

Gas.	Liquid.		Solid.		Observer.
	Temp. °C.	D g/cm³.	Temp. °C.	D g/cm³.	
Acetylene	− 23.5	0.52			Mathias, 1909
	30.8	0.40			
Air (20.9% oxygen)	−147.	0.92			
Ammonia	− 10.7	0.65			Andreeff, 1859
	+ 16.3	0.61			Andreeff, 1859
Argon	−187.*	1.41			Baly & Donnan, 1902
Carbon dioxide	− 60.	1.19	− 79.	1.53	Behn, 1910
	+ 20.	0.77			Amagat
Carbon monoxide	−190.*	.79			
	− 68.	.86			Baly & Donnan
Chlorine	− 33.6*	1.56			Knietsch, 1890
Chlorine	+ 20.	1.41			Knietsch, 1890
Ethylene	− 21.	0.41			Cailletet & Mathias, 1886
Ethylene	+ 10.	0.21			
Helium	−269.*	0.122			Kamerling-Onnes & Perrier, 1910
Hydrogen	−253.*	0.07	−260.	.076	Dewar, 1904
Hydrogen sulphide	− 61.	0.86			
Nitrogen	−196.*	0.804	−253.	1.03	Dewar, 1904
Nitrous oxide	− 20.	1.0			Cailletet & Mathias
Nitrous oxide	+ 17.	.80			Villard, 1897
Oxygen	− 23.	0.89			Cailletet & Hautefeuille, 1881
	−182.7*	1.14	−253.	−1.41	Kamerling-Onnes & Perrier, 1910
	−205.	1.25			Baly & Donnan
Sulphur dioxide	− 10.*	1.46			Pierre
	+ 20.	1.38			Cailletet & Mathias

ELASTIC CONSTANTS FOR SOLIDS

YOUNG'S MODULUS AND MODULUS OF RIGIDITY

The values can be considered only as approximations. They are for ordinary atmospheric temperatures.

Material.	Young's Modulus.		Modulus of rigidity.	
	Dynes per sq.cm.	Pounds per sq.in.	Dynes per sq.cm.	Pounds per sq.in.
Aluminum	7×10^{11}	10.2×10^{6}	2.5×10^{11}	3.63×10^{6}
Bismuth	3.2	4.65	1.24	1.80
Brass	9.2	13.4	3.7	5.38
Bronze	10.6	15.4	4.06	5.91
phosphor	12.0	17.4	4.36	6.32
Cadmium	5.0	7.26	2.45	3.56
Copper	10.	14.5	4.2	6.10
German silver	10.8	15.7	4.5	6.54
Glass ordinary	4.7–7.8	6.83–11.3	1.8–3.2	2.62–4.65
crown	6.5–7.8	9.45–11.3	2.6–3.2	3.78–4.65
flint	5.0–6.0	7.26–8.52	2.0–2.5	2.91–3.63
Gold, pure	8.0	11.6	3.0	4.36
Granite	1.46	2.12		
Ice	.28	.407		
Iron, drawn	20.0	29.1	8.00	11.6
cast	11.5	16.8	5.10	7.41

ELASTIC CONSTANTS FOR SOLIDS (Continued)

YOUNG'S MODULUS AND MODULUS OF RIGIDITY (Continued)

Gas.	Young's Modulus.		Modulus of rigidity.	
	Dynes per sq.cm.	Pounds per sq.in.	Dynes per sq.cm.	Pounds per sq.in.
Ivory	$.9\times10^{11}$	1.31×10^{6}		
Lead	1.7	2.47	0.7×10^{11}	1.02×10^{6}
Magnesium	4.2	6.10	1.7	2.47
Manganin	12.4	18.0	4.65	6.70
Nickel	22.0	32.0	8.0	11.6
Platinum	17.0	24.7	6.5	9.45
Platinum-iridium	21.4	31.1		
Quartz, crystal:				
∥ to axis	10.30	15.0		
⊥ to axis	7.85	11.4		
fiber	5.6	8.14	3.0	4.36
Rhodium	28.0	40.7		
Silver, pure	7.5	10.9	2.7	3.94
Steel, ordinary mild	22.0	32.0	8.00	11.6
cast	19.5	28.3	7.50	10.9
drawn	18.8	27.3		
invar	14.1	20.3	5.63	8.18
Tantalum	18.6	27.0		
Tin	5.0	7.26	2.0	2.91
Wood	.03–1.0	.0436–1.45		
Zinc	9.0	13.1	3.4	4.94

BULK MODULUS, LIMIT OF ELASTICITY AND BREAKING STRAIN

The values can be considered only as approximations. They are for ordinary atmospheric temperatures.

Material.	LIMIT OF ELASTICITY.		BREAKING STRAIN.		Bulk Modulus Dynes per sq.cm.
	Dynes per sq.cm.	Pounds per sq.in.	Dynes per sq.cm.	Pounds per sq.in.	
Aluminum	5.0×10^{8}	7.25×10^{3}	$10–25\times10^{8}$	$14.5–36.3\times10^{3}$	7.0×10^{11}
Bismuth	.....	.....	.....	.....	3.0
Brass	.....	.....	22.–48.	32.–70.	6.1
Bronze	5.0–12.	7.25–17.4	20.–40.	29.–58.	8.9
Cadmium	.....	.....	.....	.....	4.12
Copper	0.5–20.0	0.73–29.0	16.–45.	23.2–65.3	12.0
German silver	.....	.....	.....	.....	15.0
Glass:					
crown	.....	.....	.....	.....	4.0–5.9
flint	.....	.....	.....	.....	3.6–3.8
Gold	.....	.....	11.0	15.6	16.0
Iron:					
drawn	20.	29.	66.	96.	15.4
cast	17.	25.	33.	48.	9.6
Lead	.....	.....	3.	4.4	0.76
Manganin	.....	.....	.....	.....	12.1
Nickel	.....	.....	42.	61.	17.0
Platinum	.....	.....	36.	52.	24.0
Quartz	.....	.....	.....	.....	3.7
Silver	15.	22.	28.	41.	10.0
Steel, mild	20.–100.	29.–145.	35.–150.	51.–218.	16.0
Tin	.....	.....	8.	12.	5.0
Zinc	.....	.....	6.	8.7	3.5

COMPRESSIBILITY OF LIQUIDS

Contraction in unit volume per atmosphere.

Liquid.	Temp. °C.	Pressures in atmospheres.	Coefficient.	Observer.
Acetone.....	0.	1–500	82×10^{-6}	Amagat, 1893
	0.	500–1000	59.	"
	0.	1000–1500	47.	"
	99.5	8.94–36.5	276.	"
Amyl alcohol..	17.7	8	90.5	Röntgen, 1891
Benzene C_6H_6.	12.9	0.4–18	87.	Suchodski, 1910
	34.9	2–18	100.	"
	99.9	4.5–19	190.	"
Butyl alcohol..	17.4	8	90.	Röntgen
Carbon disulphide.....	0.	1–500	66.	Amagat, 1893
	49.2	1000–1500	51.	"
Carbon tetrachloride.....	20.	100–200	90.7	Richards, 1907
Chlorobenzene	13.	0.4–18	67.	Suchodski, 1910
	35.	0.4–18	77.	"
	100.	0.4–18	127.	"
Chloroform....	0.	.....	101.	Grimaldi, 1887
	20.	.....	128.	"
	40.	.....	162.	"
	60.	.....	204.	"
	100.	8–9	211.	Amagat
	100.	19–34	206.	"
	20.	1–98	94.	Richards&Stall, 1904
	20.	98.7–197.4	89.	Richards&Stall, 1904
	20.	197.4–296.1	80.	Richards&Stall, 1904
Ether.....	12.2	0.4–17.5	163.	Suchodski, 1910
	34.8	2–19	207.	"
	63.	8.6–34.3	293.	Amagat, 1893
	78.5	8.6–34.3	363.	"
	99.	8.6–36.5	523.	"
Ethyl acetate..	13.3	8.1–37.4	104.	"
Ethyl alcohol..	28.	150–400	81.	Barus, 1890
	65.	150–400	100.	"
	100.	150–400	132.	"
	185.	150–400	245.	"
	310.	150–400	1530.	"
	28.	150–200	86.	"
	100.	150–200	168.	"
	310.	150–200	4200.	"

COMPRESSIBILITY OF LIQUIDS (Continued)

Contraction in unit volume per atmosphere.

Liquid.	Temp. °C.	Pressures in atmospheres.	Coefficient.	Observer.
Ethyl alcohol:				
	0.	1–50	$96. \times 10^{-6}$	Amagat, 1893
	20.	1–50	112.	"
	40.	1–50	125.	"
	0.	100–200	85.	"
	0.	300–400	73.	"
	0.	500–600	64.	"
	0.	900–1000	52.	"
Ethyl bromide.	10.1	1–500	89.6	Amagat
	10.1	500–1000	63.4	"
	13.7	0.4–18.5	113.	Suchodski, 1910
	35.	2–19	138.	"
Ethyl chloride.	0.	1–500	103.	Amagat, 1893
	0.	500–1000	69.2	"
	11.	8.5–34.2	138.	"
	62.	12.7–32.8	255.	"
	99.	12.8–34.5	495.	"
Ethyl iodide.	10.6	1–500	73.8	Amagat
		500–1000	56.2	"
Fluor-benzene.	13.9	0.4–18	88.	Suchodski, 1910
	35.3	0.4–18	103.	"
	99.7	4.3–18.5	190.	"
Glycerine.	14.9	1–10	22.	De Metz, 1890
Mercury.	0.	.....	3.92	Amagat
	15.	100–200	3.76	Richards, 1907
Methyl acetate	14.3	8.1–37.5	97.	Amagat
	99.	8.3–37	250.	"
Methyl alcohol	0.	1–500	79.4	"
	0.	500–1000	58.3	"
	14.7	8.5–371	104.	"
	100.	8.7–37.3	221.	"
Nitric acid.	20.3	1–32	338.	.....
Palmitic acid.	65.	20–100	88.	Barus, 1890
	100.	20–100	99.	"
Paraffine.	64.	20–100	84.	"
	100.	20–100	107.	"
Oil, almond.	17.	.....	55.	Quincke
olive.	20.5	.....	63.	"
turpentine.	19.7	.....	79.	"
Toluene.	10.	1–5.25	79.	DeHeen, 1885
	100.	1–5.25	150.	" "
Xylene.	10.	1–5.25	74.	" "
	100.	1–5.25	132.	" "

COMPRESSIBILITY OF LIQUIDS (Continued)

Contraction in unit volume per atmosphere.

Liquid.	Temp. °C.	Pressures in atmospheres.	Coefficient.	Observer.
Water.....	0.	1–25	52.5×10^{-6}	Amagat, 1893
	10.	1–25	50.0	"
	20.	1–25	49.1	"
	0.	25–50	51.6	"
	10.	25–50	49.2	"
	20.	25–50	47.6	"
	0.	100–200	49.2	"
	10.	100–200	46.1	"
	20.	100–200	44.2	"
	50.	100–200	42.5	"
	100.	100–200	46.8	"
	0.	500–1000	41.6	"
	0.	1000–1500	35.8	"
	0.	1500–2000	32.4	"
	0.	2000–2500	29.2	"
	0.	2500–3000	26.1	"

ELASTIC CONSTANTS FOR GASES

For short ranges of pressure, at a constant temperature, the volume of gas is inversely proportional to the pressure or pressure ×volume =a onstant. (Boyle's Law.)

For high pressures, the table below shows the relative volumes at various emperatures. The volume at 0° C. and 76 cm. pressure (1 atmosphere) eing taken as 1,000,000.

(From Smithsonian Tables.)

Atm.	Oxygen.			Air.		
	0°	99°.5	199°.5	0°	99°.4	200°.4
100	9265	.....	.....	9730		
200	4570	7000	9095	5050	7360	9430
300	3208	4843	6283	3658	5170	6622
400	2629	3830	4900	3036	4170	5240
500	2312	3244	4100	2680	3565	4422
600	2115	2867	3570	2450	3180	3883
700	1979	2610	3202	2288	2904	3502
800	1879	2417	2929	2168	2699	3219
900	1800	2268	2718	2070	2544	3000
1000	1735	2151	.....	1992	2415	2828

Atm.	Nitrogen.			Hydrogen.		
	0°	99°.5	199°.6	0°	99°.3	200°.5
100	9910					
200	5195	7445	9532	5690	7567	9420
300	3786	5301	6715	4030	5286	6520
400	3142	4265	5331	3207	4147	5075
500	2780	3655	4515	2713	3462	4210
600	2543	3258	3973	2387	3006	3627
700	2374	2980	3589	2149	2680	3212
800	2240	2775	3300	1972	2444	2900
900	2149	2616	3085	1832	2244	2657
1000	2068	.....	.....	1720	2093	

COEFFICIENT OF FRICTION

(From Rankine's Compilation, 1858; Smithsonian Tables.)

Materials.	Coefficient of friction.	Angle of repose in degrees.
Wood on wood, dry	.25–.50	14.0–26.5
Wood on wood, soapy	.20	11.5
Metals on oak, dry	.50–.60	26.5–31.0
Metals on oak, wet	.24–.26	13.5–14.5
Metals on oak, soapy	.20	11.5
Metals on elm, dry	.20–.25	11.5–14.0
Hemp on oak, dry	.53	28.0
Hemp on oak, wet	.33	18.5
Leather on oak	.27–.38	15.0–19.5
Leather on metals, dry	.56	29.5
Leather on metals, wet	.36	20.0
Leather on metals, greasy	.23	13.0
Leather on metals, oily	.15	8.5
Metals on metals, dry	.15–.20	8.5–11.5
Metals on metals, wet	.3	16.5
Smooth surfaces occasionally greased	.07–.08	4.0–4.5
Smooth surfaces continually greased	.05	3.0
Smooth surfaces, best results	.03–.036	1.75–2.0
Steel on agate, dry	.20	11.5
Steel on agate, oiled	.107	6.1
Iron on stone	.30–.70	16.7–35.0
Wood on stone	about .40	22.0
Masonry and brick work, dry	.60–.70	33.0–35.0
Masonry and brick work, damp mortar	.74	36.5
Masonry on dry clay	.51	27.0
Masonry on moist clay	.33	18.25
Earth on earth	.25–1.00	14.0–45.0
Earth on earth, dry sand, clay and mixed earth	.38–.75	21.0–37.0
Earth on earth, damp clay	1.00	45.0
Earth on earth, wet clay	.31	17.0
Earth on earth, shingle and gravel	.81–1.11	39.0–48.0

RESISTANCE TO CRUSHING FOR VARIOUS MATERIALS

Approximate values in pounds per square inch.

Material.	Resistance to crushing in lbs. per sq. in.	Material.	Resistance to crushing in lbs. per sq.in.
Brick:		Granite	9700–34000
soft burned	3000–6000	Limestone	6000–25000
hard burned	4500–6500	Marble	7600–20700
vitrified	8500–25000	Sandstone	2400–29300
Brownstone	7300–23600	Tufa	7700–11600
Concrete	800–3800		

TENSILE STRENGTH OF METALS

(Selected from Smithsonian Tables.)

Given in pounds per square inch. The values can be considered only as approximations.

Metal.	Tensile Strength in lbs. per sq. in.
Aluminum wire	30000–40000
Brass wire	50000–150000
Bronze wire, phosphor, hard drawn	110000–140000
Bronze wire, silicon, hard drawn	95000–115000
Bronze	60000–75000
Cobalt, cast	33000
Copper wire, hard drawn	60000–70000
German silver	40000–50000
Gold wire	20000
Iron, cast	13000–33000
Iron wire, hard drawn	80000–120000
Iron wire, annealed	50000–60000
Lead, cast or drawn	2600–3300
Magnesium, hard drawn	33000
Monel metal, cold drawn	80000–100000
Nickel, hard drawn	155000
Palladium	39000
Platinum wire	50000
Silver wire	42000
Steel	80000–330000
Steel wire, maximum	460000
Steel, specially treated nickel steel	250000
Steel, piano wire, 0.033 in. diam.	357000–390000
Steel, piano wire, 0.051 in. diam.	325000–337000
Tantalum	130000
Tin, cast or drawn	4000–5000
Tungsten, hard drawn	590000
Zinc, cast	7000–13000
Zinc, drawn	22000–30000

MODULUS OF RUPTURE. TRANSVERSE TESTS FOR VARIOUS WOODS

(Smithsonian Tables.)

Material.	Modulus, lbs. per sq.in.	Material.	Modulus, lbs. per sq.in.
Ash, white	10,800	Maple, sugar	16,500
Basswood	8,340	Maple, white	14,640
Beech	16,200	Oak, red	11,400
Cedar, red	11,800	Oak, white	13,100
Cedar, white	6,300	Pine, white	7,900
Cypress, bald	7,900	Pine, red	9,100
Elm, white	10,300	Poplar	9,400
Fir, red	13,270	Spruce, pine	10,000
Hemlock	9,480	Walnut, black	11,900
Hickory, pignut	18,700		

HARDNESS

Scale of Hardness

1	Talc	4	Fluorite	8	Topaz
2	Rocksalt	5	Apatite	9	Corundum
3	Calcite	6	Feldspar	10	Diamond
		7	Quartz		

Hardness of Materials

The numbers give only the order of arrangement as to hardness.

(From Smithsonian Tables.)

Agate	7.	Hematite	6.
Alabaster	1.7	Hornblende	5.5
Alum	2–2.5	Iridium	6.
Aluminum	2.	Iridosmium	7.
Amber	2–2.5	Iron	4–5.
Andalusite	7.5	Kaolin	1.
Anthracite	2.2	Lead	1.5
Antimony	3.3	Loess (0°)	0.3
Apatite	5.	Magnetite	6.
Aragonite	3.5	Marble	3–4.
Arsenic	3.5	Meerschaum	2–3.
Asbestos	5.	Mica	2.8
Asphalt	1–2.	Opal	4–6.
Augite	6.	Orthoclase	6.
Barite	3.3	Palladium	4.8
Beryl	7.8	Phosphor bronze	4.
Bell-metal	4.	Platinum	4.3
Bismuth	2.5	Plat-iridium	6.5
Boric acid	3.	Pyrite	6.3
Brass	3–4.	Quartz	7.
Calanime	5.	Rock-salt	2.
Calcite	3.	Ross' metal	2.5–3.0
Copper	2.5–3.	Silver chloride	1.3
Corundum	9.	Sulphur	1.5–2.5
Diamond	10.	Stibnite	2.
Dolomite	3.5–4.	Serpentine	3–4.
Feldspar	6.	Silver	2.5–3.
Flint	7.	Steel	5–8.5
Fluorite	4.	Talc	1.
Galena	2.5	Tin	1.5
Garnet	7.	Topaz	8.
Glass	4.5–6.5	Tourmaline	7.3
Gold	2.5–3.	Wax (0°)	0.2
Graphite	0.5–1.	Wood's metal	3.
Gypsum	1.6–2.	Zinc	2.5

SURFACE TENSION OF VARIOUS LIQUIDS IN CONTACT WITH AIR

(Compiled from Various Sources.)

Liquid.	Temp. ° C.	Tension, dynes per cm.	Observer.
Acetic acid	20	23.5	Ramsay & Shields
Acetone	17.6	23.3	Jaeger
Alcohol, ethyl	20	21.7	Magie
Alcohol, methyl	20	23.0	Ramsay & Shields
Anilin	17.5	44.1	Volkmann
Benzol (C_6H_6)	22.5	29.4	Cantor
Bromine	−21	62.1	Quincke
Carbon disulphide	20	31.7	Magie
Chloroform	20	26.7	Magie
Ether	20	16.8	Brunner
Glycerine	18	65.2	Cantor
Hydrochloric acid	20	72.9	Quincke
Mercury	18	520.	
Oil, olive	20	33.5	Mean of various
Oil, turpentine	20	27.1	Mean of various
Petroleum	20	25.9	Magie

SURFACE TENSION OF AQUEOUS SOLUTIONS

Salt in solution.	Density of solution.	Temp. ° C.	Tension in dynes per cm. against air.
Barium chloride	1.282	15–16	81.8
Calcium chloride	1.351	19	95.0
Calcium chloride	1.277	19	90.2
Copper sulphate	1.178	15–16	78.6
Hydrochloric acid	1.119	20	73.6
Hydrochloric acid	1.089	20	74.5
Hydrochloric acid	1.024	20	75.3
Potassium chloride	1.170	15–16	82.8
Potassium chloride	1.101	15–16	80.1
Sodium chloride	1.193	20	85.8
Sodium chloride	1.107	20	80.5
Sodium nitrate	1.302	12	83.5
Sodium oleate	saturated	20	25.0
Sulphuric acid	1.445	15	79.7
Sulphuric acid	1.264	15	79.7
Zinc sulphate	1.398	15–16	83.3
Zinc sulphate	1.104	15–16	77.8

SURFACE TENSION OF FUSED SOLIDS

Substance	Gas with which liquid is in contact	Temp. ° C.	Surface tension dynes per cm.		Substance	Gas with which liquid is in contact	Temp. ° C.	Surface tension dynes per cm.	
Antimony	—	840–850	274	(1)	Mercury				
	—	—	317.2	(2)		Air	200	436	(5)
Bismuth	—	700–850	346	(1)		Air	300	405	(5)
	—	—	464.9	(2)		Air	354	394	(5)
	Hydrogen	269	378	(5)	Phosphorus	Carbon dioxide	Fusion	41.2	(2)
	Hydrogen	365	371	(5)	Platinum	Air	2000	1658	(2)
	Hydrogen	426	367	(5)	Potassium	—	58	371	(2)
	Hydrogen	472	365	(5)	Potassium Chloride	—	Fusion	93	(2)
Borax	Air	Fusion	950	(2)					
Cadmium	—	—	815	(2)	Silver	Air	1000	782	(2)
	—	—	832	(4)		—	980-1120	858	(1)
	Hydrogen	320	630	(5)		—	—	751.0	(6)
	Hydrogen	421	622	(5)	Selenium	—	—	92.5	(2)
	Hydrogen	544	616	(5)	Sodium	—	90	258	(2)
Copper	—	1150	1178	(1)	Sodium Chloride	—	Fusion	115	(2)
Gold	—	1120	1018	(1)					
	—	—	581	(2)	Sugar	Air	160	66.9	(2)
	Air	1070	612.2	(3)	Sulfur	Air	111	42	(2)
Iron	Air	Fusion	950	(2)		—	60	11.56	(9)
Lead	—	770–780	424.5	(1)	Tin	—	750–910	480	(1)
	—	—	535.9	(2)		—	—	681.2	(2)
	—	—	509.5	(4)		—	—	612.4	(4)
	Hydrogen	327	444	(5)		—	—	352	(7)
	Hydrogen	522	429	(5)		Hydrogen	232	531	(5)
Mercury	—	15–17	447.5	(1)		Hydrogen	319	519	(5)
	—	—	547.2	(2)		Hydrogen	396	520	(5)
	—	—	491.2	(7)	Zinc	—	580–630	707.5	(1)
	—	—	435.6	(8)		—	—	967.4	(2)
	Air	−39	467	(5)		Hydrogen	419	758	(5)
	Air	20	465	(5)		Hydrogen	543	747	(5)
	Air	110	447	(5)					

Authorities: (1) S. W. Smith; (2) Quincke; (3) Heydweiller; (4) Siedentopf; (5) Hogness; (6) Gradenwitz; (7) Grunmach; (8) Stöckle; (9) Rudge.

SURFACE TENSION OF WATER AND ALCOHOL

SURFACE TENSION FOR WATER AND ALCOHOL (ETHYL) IN CONTACT WITH AIR IN DYNES PER CENTIMETER
(From Smithsonian Tables.)

Temp. ° C.	Surface tension, dynes per centimeter.		Temp. ° C.	Surface tension, dynes, per centimeter.	
	Water.	Ethyl alcohol.		Water.	Ethyl alcohol.
0	75.6	23.5	55	67.8	18.6
5	74.9	23.1	60	67.1	18.2
10	74.2	22.6	65	66.4	17.8
15	73.5	22.2	70	65.7	17.3
20	72.8	21.7	75	65.0	16.9
25	72.1	21.3	80	64.3	
30	71.4	20.8	85	63.6	
35	70.7	20.4	90	62.9	
40	70.0	20.0	95	62.2	
45	69.3	19.5	100	61.5	
50	68.6	19.1			

VISCOSITY

The coefficient of viscosity of a substance is defined as the tangential force per unit area of either of two horizontal planes at unit distance apart, one of which is fixed, while the other moves with unit velocity, the space being filled with the substance.

In the case of a liquid flowing slowly through a long tube of small diameter, the volume V of liquid which escapes in a time t is given by the equation,

$$V = \frac{\pi p r^4}{8 l \eta} t$$

where p is the difference in pressure between the two ends of the tube; r, its radius; l, its length and η, the coefficient of viscosity. (Law of Poiseuille.)

A more complete equation is now generally used:

$$\eta = \frac{\pi d g r^4 t}{8 Q (l + \lambda)} \left(h - \frac{m v^2}{g} \right)$$

where η is the coefficient of viscosity; d, the density in gm./cm^3; r, the radius and l the length of the tube in cm.; Q, the volume in cm.^{3} discharged in t sec.; λ a correction to the length of the tube; h, the average head in cm.; m, the coefficient of the kinetic energy correction, mv^2/g; g, the acceleration due to gravity in cm./sec.^{2}; v, the mean velocity in cm./sec. See Technologic Papers of the Bureau of Standards 100 and 112, 1917 and 1918 for a full discussion.

The coefficient of viscosity is expressed in dyne-seconds per cm.^{2} or poises.

Specific viscosity is the ratio of the coefficient of viscosity of any substance to that of water at 0° C. or other specified temperature.

VISCOSITY OF WATER

Temperature C	Coefficient of Viscosity C. G. S.			Specific Viscosity Hosking 1909
	Thorpe-Rodger 1894	Hosking 1909	Bingham and Jackson, 1917	
0	0.01778	0.01793	0.01792	1.000
5	.01510	.01522	.01519	.849
10	.01303	.01310	.01308	.730
15	.01134	.01142	.01140	.637
20	.01002	.01006	.01005	.561
25	.00891	.00893	.00894	.498
30	.00798	.00800	.00801	.446
35	.00720	.00724	.00723	.404
40	.00654	.00657	.00656	.367

VISCOSITY OF WATER (Continued)

Temperature C	Coefficient of Viscosity C. G. S.			Specific Viscosity Hosking 1909
	Thorpe-Rodger 1894	Hosking 1909	Bingham and Jackson, 1917	
45	.00597	.00600	.00599	.335
50	.00548	.00550	.00549	.307
55	.00506	.00508	.00506	.283
60	.00468	.00469	.00469	.262
65	.00436	.00436	.00436	.243
70	.00406	.00406	.00406	.226
75	.00380	.00380	.00380	.212
80	.00356	.00356	.00357	.199
85	.00335	.00335	.00336	.187
90	.00316	.00316	.00317	.176
95	.00299	.00300	.00299	.167
100	.00283	.00284 *	.00284	.158
124	.....	.....	.....	.124 *
153	.00181 *	.....	.....	.101 *

* Values by Haas, 1894.

VISCOSITY OF WATER BELOW 0° C.

White-Twining, 1914

Temperature	Coefficient of Viscosity	Temperature	Coefficient of Viscosity
0° C.	0.01798	−7.23	0.02341
−2.10	.01330	−8.48	.02458
−4.70	.02121	−9.30	.02549
−6.20	.02250		

VISCOSITY OF LIQUIDS

Coefficient of viscosity of liquids including elements, organic and inorganic compounds, and mixtures. C. G. S. units.

Liquid.	Temp. ° C.	Coefficient of viscosity.	Observer.
Acetaldehyde.....	20	0.0022	Mussell-Thole-Dunstan, 191
Acetanilide.....	130	.0190	Thorpe-Rodger, 1894
Acetic acid.....	20	.01219	Thorpe-Rodger, 1894
	40	.00901	Thorpe-Rodger, 1894
	60	.00700	Thorpe-Rodger, 1894
	80	.00560	Thorpe-Rodger, 1894
	100	.00457	Thorpe-Rodger, 1894
	0	.0238	Faust, 1912

VISCOSITY OF LIQUIDS (Continued)

Liquid.	Temp. ° C.	Coefficient of viscosity.	Observer.
Acetic acid:	18	.0130	Faust, 1912
	41	.0100	Faust, 1912
	59	.0070	Faust, 1912
	70	.0060	Faust, 1912
	100	.0043	Faust, 1912
anhydride.....	0	.0124	Faust, 1912
	18	.0090	Faust, 1912
	100	.0049	Faust, 1912
Acetone.....	20	.0033	Thorpe-Rodger, 1894
	—13	.0047	Faust, 1912
	—10	.00450	Faust, 1912
	0	.00395	Faust, 1912
	14.5	.00330	Faust, 1912
	19	.00303	Faust, 1912
	35	.00278	Faust, 1912
	41	.00280	Faust, 1912
Air, liquid.....	.....	.0033	Forch, 1900
	—192.3	.00172	Verschaffelt, 1917
Alcohol. See *Ethyl alcohol.*			
Allyl alcohol.....	0	.02144	Thorpe-Rodger, 1894
	20	.01361	Thorpe-Rodger, 1894
	40	.00911	Thorpe-Rodger, 1894
	60	.00642	Thorpe-Rodger, 1894
	80	.00470	Thorpe-Rodger, 1894
amine.....	130	.00506	Mussell-Thole-Dunstan, 1921
Ammonia, NH_3.....	—33.5	.00266	Fitzgerald, 1912
Amyl acetate.....	10	.0106	Pribram-Handl, 1912
	20	.0089	Pribram-Handl, 1912
	30	.0077	Pribram-Handl, 1912
	40	.0065	Pribram-Handl, 1912
Aniline.....	20	.0440	Wijkander, 1897
	30	.0319	Wijkander, 1897
	40	.0241	Wijkander, 1897
	50	.0189	Wijkander, 1897
	0	.0865	Faust, 1912
Anisol.....	20	.0111	Gartenmeister
Benzene.....	0	.00902	Thorpe-Rodger, 1894
	20	.00649	Thorpe-Rodger, 1894
	40	.00492	Thorpe-Rodger, 1894
	60	.00390	Thorpe-Rodger, 1894
	80	.00327	Thorpe-Rodger, 1894
	0	.00850	Faust, 1912
	19.4	.00619	Faust, 1912
	50	.00418	Faust, 1912
Benzylamine.....	25	.0159	Mussell-Thole-Dunstan, 1912
Benzylaniline.....	130	.0120	Mussell-Thole-Dunstan, 1912
Bismuth	285	.0161	Plüss, 1915
	365	.0146	Plüss, 1915
Bromine.....	16	.010	Thorpe-Rodger, 1894
Butyl alcohol.....	0	.05185	Thorpe-Rodger, 1894
	20	.02947	Thorpe-Rodger, 1894
	40	.01780	Thorpe-Rodger, 1894
	60	.01136	Thorpe-Rodger, 1894
	80	.00762	Thorpe-Rodger, 1894
	100	.00534	Thorpe-Rodger, 1894
Butyric acid.....	0	.02284	Thorpe-Rodger, 1894
	20	.01538	Thorpe-Rodger, 1894
	40	.01117	Thorpe-Rodger, 1894
	60	.00853	Thorpe-Rodger, 1894
	80	.00678	Thorpe-Rodger, 1894
	100	.00545	Thorpe-Rodger, 1894

VISCOSITY OF LIQUIDS (Continued)

Liquid.	Temp. ° C.	Coefficient of viscosity.	Observer.
	20	.0163	Gartenmeister, 1890
	40	.0118	Gartenmeister, 1890
	60	.0102	Gartenmeister, 1890
Carbon dioxide, liquid	0	.00099	Warburg-Babo, 1882
	10	.00085	Warburg-Babo, 1882
	20	.00071	Warburg-Babo, 1882
	30	.00053	Warburg-Babo, 1882
pressure, 59 atm.	20	.000697	Phillips, 1912
pressure, 72 atm.	30	.000458	Phillips, 1912
disulphide.....	—13	.00514	Faust, 1912
	—10	.00495	Faust, 1912
	0	.00429	Faust, 1912
	0	.00429	Thorpe-Rodger, 1894
	20	.00367	Thorpe-Rodger, 1894
	40	.00319	Thorpe-Rodger, 1894
tetrachloride.....	20	.0096	Thorpe-Rodger, 1894
Chloroform.....	0	.00700	Thorpe-Rodger, 1894
	20	.00564	Thorpe-Rodger, 1894
	40	.00466	Thorpe-Rodger, 1894
	—13	.00855	Faust, 1912
	0	.00715	Faust, 1912
	19	.00615	Faust, 1912
	39	.00500	Faust, 1912
Carbolic acid. See *phenol*.			
Copal lac.....	22	4.80	Metz, 1903
Diethylamine.....	25	.00346	Kournakoff-Zemczuzny, 1912
	25	.00367	Mussell-Thole-Dunstan, 1912
Diethylaniline.....	25	.0195	Mussell-Thole-Dunstan, 1912
Dimethylaniline....	25	.01285	Mussell-Thole-Dunstan, 1912
Dimethyl-α-naphthylamine.....	130	.00868	Mussell-Thole-Dunstan, 1912
Dimethyl-β-naphthylamine.....	130	.00952	Mussell-Thole-Dunstan, 1912
Diphenylamine.....	130	.0104	Mussell-Thole-Dunstan, 1912
Ether (diethyl-).....	0	.00286	Thorpe-Rodger, 1894
	6.7	.00276	Thorpe-Rodger, 1894
	10	.00258	Thorpe-Rodger, 1894
	20	.00234	Thorpe-Rodger, 1894
	30	.00212	Thorpe-Rodger, 1894
	25	.00226	Baker, 1912
	0	.00300	Faust, 1912
	14	.00250	Faust, 1912
	32	.00215	Faust, 1912
Ethyl acetate.....	10	.0051	Pribram-Handl, 1878
	20	.0044	Pribram-Handl, 1878
	40	.0035	Pribram-Handl, 1878
alcohol.....	0	.01770	Thorpe-Rodger, 1894
	10	.01449	Thorpe-Rodger, 1894
	20	.01192	Thorpe-Rodger, 1894
	30	.00990	Thorpe-Rodger, 1894
	40	.00827	Thorpe-Rodger, 1894
	50	.00698	Thorpe-Rodger, 1894
	60	.00591	Thorpe-Rodger, 1894
	25	.010786	Kernot-Pomilio, 1912
aniline.....	25	.0204	Mussell-Thole-Dunstan, 1912
bromide.....	20	.00392	Thorpe-Rodger, 1894
formate.....	20	.00402	
iodide.....	20	.00583	
malate.....	24.7	.03016	Thole, 1912
Ethylene bromide...	0	.02435	Thorpe-Rodger, 1894
	20	.01716	Thorpe-Rodger, 1894

VISCOSITY OF LIQUIDS (Continued)

Liquid.	Temp. ° C.	Coefficient of viscosity.	Observer.
Ethylene bromide ..	40	.01280	Thorpe-Rodger, 1894
	70	.00895	Thorpe-Rodger, 1894
chloride.....	0	.01128	Thorpe-Rodger, 1894
	20	.00833	Thorpe-Rodger, 1894
	70	.00470	Thorpe-Rodger, 1894
Eugenol.....	25	.06931	Dunstan-Hilditch, 1912
Formic acid.....	10	.02262	Gartenmeister, 1890
	20	.01804	Gartenmeister, 1890
	30	.01465	Gartenmeister, 1890
	40	.01224	Gartenmeister, 1890
	50	.01025	Gartenmeister, 1890
Glucose.....	83	1600.	Tammann, 1899
	67	27000.	Tammann, 1899
Glycerine.....	2.8	42.20	Schöttner, 1878
	8.1	25.18	Schöttner, 1878
	14.3	13.87	Schöttner, 1878
	20.3	8.30	Schöttner, 1878
Glycerine.....	26.5	4.94	Schöttner, 1878
Glycol.....	0	.0218	Arrhenius
Heptane.....	0	.00519	Thorpe-Rodger, 1894
	20	.00410	Thorpe-Rodger, 1894
	40	.00344	Thorpe-Rodger, 1894
	60	.00276	Thorpe-Rodger, 1894
Hexane.....	0	.00397	Thorpe-Rodger, 1894
	20	.00320	Thorpe-Rodger, 1894
	40	.00264	Thorpe-Rodger, 1894
	60	.00221	Thorpe-Rodger, 1894
Hydrogen.....	liq.	.00011	Verschaffelt, 1917
Isoamyl-amine.....	25	.00724	Mussell-Thole-Dunstan, 1912
Isobutyl-amine.....	25	.00553	Mussell-Thole-Dunstan, 1912
Isobutyric acid.....	20	1.318	Thorpe-Rodger, 1894
Isoeugenol.....	25	.2672	Dunstan-Hilditch, 1912
Isoheptane.....	0	.00477	Thorpe-Rodger, 1894
	20	.00379	Thorpe-Rodger, 1894
	40	.00309	Thorpe-Rodger, 1894
Isohexane.....	0	.00371	Thorpe-Rodger, 1894
	20	.00300	Thorpe-Rodger, 1894
	40	.00247	Thorpe-Rodger, 1894
Isopentane.....	0	.00273	Thorpe-Rodger, 1894
	20	.00223	Thorpe-Rodger, 1894
Isoquinoline.....	25	.0357	Mussell-Thole-Dunstan, 1912
Isosafrol.....	25	.03981	Dunstan-Hilditch, 1912
Menthol.....	34.9	.069	Heydweiller
Mercury.....	−20	.0184	Koch, 1881
	0	.0170	Koch, 1881
	20	.0157	Koch, 1881
	100	.0122	Koch, 1881
	200	.01015	Koch, 1881
	300	.00928	Koch, 1881
	0	.01661	Plüss, 1915
	20	.01547	Plüss, 1915
	34	.01476	Plüss, 1915
	98	.01263	Plüss, 1915
	193	.01079	Plüss, 1915
	299	.00975	Plüss, 1915
Methyl acetate.....	0	.00478	
alcohol.....	0	.00813	Thorpe-Rodger, 1894
	20	.00591	Thorpe-Rodger, 1894
	40	.00450	Thorpe-Rodger, 1894
	60	.00349	Thorpe-Rodger, 1894
amine.....	0	.00236	Fitzgerald, 1912
aniline.....	25	.0200	Kournakoff-Zemczuzny, 1912

VISCOSITY OF LIQUIDS (Continued)

Liquid.	Temp. ° C.	Coefficient of viscosity.	Observer.
Methyl aniline	25	.0202	Mussell-Thole-Dunstan, 1912
iodide	0	.00594	
	20	.00487	
	40	.00409	
Nitric acid	0	.02275	
	10	.01770	
Octane	0	.00703	Thorpe-Rodger, 1894
	20	.00538	Thorpe-Rodger, 1894
	40	.00428	Thorpe-Rodger, 1894
Oil, castor	10	24.2	Kahlbaum-Raber, 1918
	20	9.86	Kahlbaum-Raber, 1918
	30	4.51	Kahlbaum-Raber, 1918
	40	2.31	Kahlbaum-Raber, 1918
	100	.169	Kahlbaum-Raber, 1918
cylinder, filtered	37.8	2.406	Archbutt-Deeley, 1912
	100	.187	Archbutt-Deeley, 1912
dark	37.8	4.224	Archbutt-Deeley, 1912
	100	.240	Archbutt-Deeley, 1912
linseed	30	.331	White, 1912
	50	.176	White, 1912
	90	.071	White, 1912
machine, light	15.6	1.138	Archbutt-Deeley, 1912
	37.8	.342	Archbutt-Deeley, 1912
	100	.049	Archbutt-Deeley, 1912
heavy	15.6	6.606	Archbutt-Deeley, 1912
	37.8	1.274	Archbutt-Deeley, 1912
olive	10	1.38	Higgins, 1914
	20	.840	Higgins, 1914
	40	.363	Higgins, 1914
	70	.124	Higgins, 1914
rape	0	25.3	Meyer
	10	3.85	Meyer
	20	1.63	Meyer
	30	.96	Meyer
soya bean	30	.406	White, 1912
	50	.206	White, 1912
	90	.078	White, 1912
sperm	15.6	.420	Archbutt-Deeley, 1912
	37.8	.185	Archbutt-Deeley, 1912
	100	.046	Archbutt-Deeley, 1912
Pentane	0	.00283	Thorpe-Rodger, 1894
	20	.00232	Thorpe-Rodger, 1894
Phenol	18.3	.127	Scarpa, 1903
	90	.0126	Scarpa, 1903
Potassium bromide	745	.0148	Lorenz, 1912
	775	.0134	Lorenz, 1912
	805	.0119	Lorenz, 1912
nitrate	334	.021	
	358	.017	
	333	.0297	Lorenz, 1912
	418	.0200	Lorenz, 1912
Propionic acid	10	.0125	Rellstab, 1868
	20	.0107	Rellstab, 1868
	40	.0080	Rellstab, 1868
Propyl acetate	10	.0066	Pribram-Handl, 1879
	20	.0059	Pribram-Handl, 1879
	40	.0044	Pribram-Handl, 1879
alcohol	0	.03882	Thorpe-Rodger, 1894
	20	.02255	Thorpe-Rodger, 1894
	40	.01403	Thorpe-Rodger, 1894
	60	.00919	Thorpe-Rodger, 1894
	80	.00628	Thorpe-Rodger, 1894

VISCOSITY OF LIQUIDS (Continued)

Liquid.	Temp. ° C.	Coefficient of viscosity.	Observer.
Propyl aldehyde	10	.0047	Thorpe-Rodger, 1894
	20	.0041	Thorpe-Rodger, 1894
	40	.0033	Thorpe-Rodger, 1894
bromide	0	.00645	Thorpe-Rodger, 1894
	20	.00517	Thorpe-Rodger, 1894
	40	.00291	Thorpe-Rodger, 1894
chloride	0	.00436	Thorpe-Rodger, 1894
	20	.00352	Thorpe-Rodger, 1894
	40	.00291	Thorpe-Rodger, 1894
Salicylic acid	10	.0320	Rellstab, 1868
	20	.0271	Rellstab, 1868
	40	.0181	Rellstab, 1868
Sodium bromide	762	.0142	Lorenz, 1912
	780	.0128	Lorenz, 1912
chloride	841	.0130	Lorenz, 1912
	896	.0101	Lorenz, 1912
	924	.0097	Lorenz, 1912
nitrate	308	.02919	Lorenz, 1912
	348	.02439	Lorenz, 1912
	398	.01977	Lorenz, 1912
	418	.01828	Lorenz, 1912
Sugar	124.6	1900	Tammann, 1899
	109	28000	Tammann, 1899
Sulphur	86	.22	Rotinjanz, 1908
	100	.16	Rotinjanz, 1908
	110	.12	Rotinjanz, 1908
	170	320	Rotinjanz, 1908
	180	550	Rotinjanz, 1908
	187	560	Rotinjanz, 1908
	200	500	Rotinjanz, 1908
	300	24	Rotinjanz, 1908
	340	6.2	Rotinjanz, 1908
	380	2.5	Rotinjanz, 1908
	420	1.13	Rotinjanz, 1908
	448	.80	Rotinjanz, 1908
Sulphur d oxide, liquid	—33.5	.005508	Fitzgerald, 1912
	—10.5	.004285	Fitzgerald, 1912
	0.1	.003936	Fitzgerald, 1912
Sulphuric ac d	20	.22	Graham. 1849
	11.2	.31953	Poiseuille
Toluene	0	.00768	Thorpe-Rodger, 1894
	20	.00586	Thorpe-Rodger, 1894
	40	.00466	Thorpe-Rodger, 1894
	60	.00381	Thorpe-Rodger, 1894
Turpentine	0	.0225	Glaser
	10	.0178	Glaser
	2	.0149	Glaser
	30	.0127	Glaser
Turpentine, Venice	17.3	1300	Landenburg, 1906
Xylene (xylol) · ortho	0	.01102	Thorpe-Rodger, 1894
	20	.00807	Thorpe-Rodger, 1894
	40	.00623	Thorpe-Rodger, 1894
meta	0	.00802	Thorpe-Rodger, 1894
	20	.00615	Thorpe-Rodger, 1894
	40	.00491	Thorpe-Rodger, 1894
para	20	.00643	Thorpe-Rodger, 1894
	40	.00508	Thorpe Rodger, 1894
Zinc	380	.0168	Plüss, 1915
	357	.0142	Plüss, 1915
	389	.0131	Plüss, 1915

VISCOSITY OF GASES

Coefficient of viscosity of gases and vapors. C. G. S. units.

Gas or vapor.	Temp. C.	Coefficient of viscosity.	Observer.
Acetic acid, vap.....	119.1	107.0×10^{-6}	Meyer-Schumann, 1881
Acetone, vap.....	0	72.5	Puluj, 1874
	18	78.0	Puluj, 1874
Air.....	−21.5	157.3	Puluj, 1874
	0	170.5	Puluj, 1874
	197.3	253.8	Puluj, 1874
	272.4	284.0	Puluj, 1874
	340	304.0	Puluj, 1874
	0	167.9	Schumann, 1884
	10	178.0	Schumann, 1884
	20	172.4	Schumann, 1884
	30	183.6	Schumann, 1884
	40	189.6	Schumann, 1884
	60	202.2	Schumann, 1884
	80	215.3	Schumann, 1884
	100	229.0	Schumann, 1884
	−24.4	163.9	Breitenbach, 1901
	0	173.3	Breitenbach, 1901
	15	180.7	Breitenbach, 1901
	99.1	220.3	Breitenbach, 1901
	182.4	255.9	Breitenbach, 1901
	302.0	299.3	Breitenbach, 1901
	15	181.0	Markowski, 1904
	99.6	221.0	Markowski, 1904
	0	171.0	Hogg, 1905
	0	170.0	Grindlay-Gibson, 1908
	0	171.0	Fisher, 1909
	20.2	181.2	Gilchrist
	23	184.40	"Probable value," Millikan, 1913
	0	172.4	Vogel, 1914
Alcohol. See *ethyl*, *methyl*, etc.			
Ammonia.....	0	96	Graham, 1846
	20	108	Graham, 1846
Argon.....	0	210.4	Schultz, 1901
	14.7	220.8	Schultz, 1901
	17.8	224.1	Schultz, 1901
	99.7	273.3	Schultz, 1901
	183.7	322.1	Schultz, 1901
Benzene, vapor.....	0	68.9	Schumann, 1884
	19	79.2	Schumann, 1884
	70.1	100.7	Schumann, 1884
	100	117.6	Schumann, 1884
Bromine, vapor.....	285.9	151.1	Rankine, 1914
	338.8	170.5	Rankine, 1914
	372.8	188.5	Rankine, 1914
	412.8	207.9	Rankine, 1914
	452.8	227.3	Rankine, 1914
	493.4	248.0	Rankine, 1914
Bromoform, vapor....	151.2	253.0	Steudel, 1882
Butyl alcohol			
normal vapor	116.9	143	Steudel, 1882
tertiary vapor....	82.9	160	Steudel, 1882
chloride, normal vapor	78	149.5	Steudel, 1882
iodide, vapor.....	130	202	Steudel, 1882
Butyric acid, vapor ..	161.7	130.0	Meyer-Schumann, 1881
Carbon dioxide.....	0	141.4	Graham, 1846
	20	160.0	Graham, 1846
	20	161.4	Maxwell, 1860

VISCOSITY OF GASES (Continued)

Gas or vapor.	Temp. C.	Coefficient of viscosity.	Observer.
Carbon dioxide.....	20	160.0	Mayer-Springmuhl, 1873
	—21	129.4	Breitenbach, 1901
	0	139.0	Breitenbach, 1901
	15	145.7	Breitenbach, 1901
	99.1	186.1	Breitenbach, 1901
	182.4	222.1	Breitenbach, 1901
	302.0	268.2	Breitenbach, 1901
	12.6	145.0	Roberts, 1912
pressure, 1 atm....	20	148.0	Phillips, 1912
	30	153	Phillips, 1912
	32	155	Phillips, 1912
	35	156	Phillips, 1912
	40	157	Phillips, 1912
pressure, 20 atm...	20	156	Phillips, 1912
pressure, 40 atm...	20	166	Phillips, 1912
pressure, 50 atm...	20	177	Phillips, 1912
pressure, 56 atm...	20	186	Phillips, 1912
disulphide, vapor...	16.9	92.4	Puluj, 1874
monoxide.....	0	163.0	Graham, 1846
	20	184.0	Graham, 1846
	—149.2	86.9	Zimmer, 1912
	—78.9	128.7	Zimmer, 1912
	—42.3	148.3	Zimmer, 1912
	0.0	168.9	Zimmer, 1912
	11.4	174.9	Zimmer, 1912
tetrachloride, vapor	76.7	195.0	Steudel, 1882
Chlorine.....	0	128.7	Graham, 1846
	20	147.0	Graham, 1846
	12.7	129.7	Rankine, 1912
	99.1	168.8	Rankine, 1912
Chloroform, vapor....	0	95.9	Puluj, 1874
	17.4	102.9	Puluj, 1874
	0	99.0	Breitenbach, 1901
	17.4	103	Breitenbach, 1901
	61	189	Breitenbach, 1901
Cyanogen.....	0	94.8	Graham, 1846
	20	107.0	Graham, 1846
Ether (diethyl-), vapor	0	68.9	Puluj, 1874
	16.1	73.2	Puluj, 1874
	36.5	79.3	Puluj, 1874
Ethyl acetate, vapor...	77.1	152.0	Meyer-Schumann, 1881
alcohol, vapor.....	0	87.4	Puluj, 1874
	16.8	88.5	Puluj, 1874
	78.4	142.0	Steudel, 1882
bromide, vapor.....	38.4	186.5	Steudel, 1882
butyrate, vapor.....	119.8	160.0	Meyer-Schumann, 1881
chloride, vapor.....	0	93.5	Graham, 1846
	20	105.0	Graham, 1846
	16.4	94.1	Obermayer, 1875
	53.5	105.0	Obermayer, 1875
	157.3	144.0	Obermayer, 1875
formate, vapor.....	53.7	156.0	Meyer-Schumann, 1881
iodide, vapor.....	72.3	216.0	Steudel, 1882
Ethylene.....	0	96.6	Graham, 1846
	20	109.0	Graham, 1846
	—21.2	89.1	Breitenbach, 1901
	15	101.6	Breitenbach, 1901
	99.3	127.8	Breitenbach, 1901
	182.4	153.0	Breitenbach, 1901
	302.6	182.6	Breitenbach, 1901
	—75.7	69.9	Zimmer, 1912
	—44.1	76.9	Zimmer, 1912

VISCOSITY OF GASES (Continued)

Gas or vapor.	Temp. C.	Coefficient of viscosity.	Observer.
Ethylene	−38.6	78.5	Zimmer, 1912
	0	90.7	Zimmer, 1912
	13.8	95.4	Zimmer, 1912
bromide, vapor	131.6	221.0	Steudel, 1882
chloride, vapor	83.5	168.0	Steudel, 1882
Helium	0	189.1	Schultz, 1901
	15.3	196.9	Schultz, 1901
	66.6	234.8	Schultz, 1901
	184.6	269.9	Schultz, 190
Hydrogen	W 20	93.0	Graham, 1846
	15.3	89.2	Obermayer, 1877
	15.9	92.9	Puluj, 1878
	20	97.0	Maxwell, 1868
	15	97.0	Rossander, 1900
	−20.6	81.9	Breitenbach, 1901
	15	88.9	Breitenbach, 1901
	99.2	105.9	Breitenbach, 1901
	182.4	121.5	Breitenbach, 1901
	302.0	139.2	Breitenbach, 1901
	12.3	86.4	Roberts, 1912
	0	86.7	Jeans, 1916
Hydrogen sulphide	0	115.4	Graham, 1846
	20	130.0	Graham, 1846
Iodine, vapor	124	184.3	Rankine, 1915
	247	240.1	Rankine, 1915
Isobutyl acetate, vapor	16.1	76.4	Schumann, 1884
	116.4	155.0	Schumann, 1884
alcohol, vapor	108.4	144.5	Steudel, 1882
bromide, vapor	92.3	179.5	Steudel, 1882
butyrate, vapor	156.9	167.0	Meyer-Schumann, 1881
chloride, vapor	68.5	150.0	Steudel, 1882
iodide, vapor	120	204.7	Steudel, 1882
Isopropyl alcohol, vapor	82.8	162.0	Steudel, 1882
bromide, vapor	60	176.0	Steudel, 1882
chloride, vapor	37	148.5	Steudel, 1882
iodide, vapor	89.3	201.5	Steudel, 1882
Krypton	15	246	Rankine, 1910
Mercury, vapor	0	183	Koch, 1883
	300	532	Koch, 1883
	380	656	Koch, 1883
Methane	0	104.0	Graham, 1846
	20	120.1	Graham, 1846
Methyl acetate, vapor	57.3	152.0	Meyer-Schumann, 1881
alcohol, vapor	66.8	135.0	Steudel, 1882
chloride	0	102.5	Graham, 1846
	20	116.0	Graham, 1846
	−15.3	93.6	Breitenbach, 1901
	15	105.2	Breitenbach, 1901
	99.1	138.4	Breitenbach, 1901
	182.4	170.6	Breitenbach, 1901
	302.0	213.9	Breitenbach, 1901
iodide, vapor	44	232	Steudel, 1882
Neon	15	312	Rankine, 1910
Nitrogen	0	163.5	Graham, 1846
	20	184.0	Graham, 1846
	−21.5	156.3	Obermayer, 1875
	10.9	170.7	Obermayer, 1875
	53.5	189.4	Obermayer, 1875
Nitric oxide	0	164.5	Graham, 1846
	20	186.0	Graham, 1846
Nitrous oxide	0	140.8	Graham, 1846
	20	160.0	Graham, 1846

VISCOSITY OF GASES (Continued)

Gas or vapor.	Temp. C.	Coefficient of viscosity.	Observer.
Nitious oxide	−21.5	124.9	Obermayer, 1875
	53.6	160.6	Obermayer, 1875
	100.3	182.9	Obermayer, 1875
Oxygen	20	212.0	Graham, 1846
	15.4	195.7	Obermayer, 1876
	53.5	215.9	Obermayer, 1876
	20	206.0	Meyer-Springmuhl, 1873
Propyl alcohol, vapor	97.4	142.0	Steudel, 1882
bromide, vapor	70.8	184.5	Steudel, 1882
iodide, vapor	102	210.0	Steudel, 1882
Sulphur dioxide	0	122.5	Graham, 1846
	20	138.0	Graham, 1846
Water, vapor	0	90.4	Puluj, 1874
	16.7	96.7	Puluj, 1874
	100	132.0	Meyer-Schumann, 1881
	15	97.5	Kundt-Warburg, 1875
Xenon	15	222.0	Rankine, 1910

VISCOSITY OF SOLIDS

C. G. S. Units.

Substance.	Temp. C.	Coefficient of viscosity.	Observer.
Glass, soda	575	11×10^{12}	Trouton and Andrews, 1904
Ice, glacier	.....	12×10^{13}	Deelev, 1908
Menthol	14.9	2×10^{12}	Heydweiller, 1897
Pitch	0	51×10^{10}	Trouton and Andrews, 1904
	15	1.3×10^{10}	Trouton and Andrews, 1904
Turpentine, Venice	18.3	1300	Trouton and Andrews, 1904
Wax, shoe makers	8	4.7×10^{6}	Trouton and Andrews, 1904

DIFFUSION

Gases into Air

Gas or vapor.	Temp. C.	Coefficient of diffusion, sq.cm./sec.	Observer.
Alcohol, vapor	40.4	0.137	Winkelmann
Carbon dioxide	0.0	0.139	Mean of various
Carbon disulphide	19.9	0.102	Winkelmann
Ether, vapor	19.9	0.089	Winkelmann
Hydrogen	0.0	0.634	Obermayer
Oxygen	0.0	0.178	Obermayer
Water, vapor	8.0	0.239	Guglielmo

Aqueous Solutions into Pure Water

Concentration in gram-molecules per liter.

Substance.	Concentration.	Temp. ° C.	Diffusion sq.cm./day.	Observer.
Acetic acid	0.2	13.5	0.77	Scheffer
	1.0	12.	0.74	Arrhenius
	2.0	12.	0.69	Arrhenius
	3.0	12.	0.68	
	4.0	12.	0.66	Arrhenius
Ammonia	1.0	15.23	1.54	Abegg
Barium chloride	0.2	8.	0.66	Scheffer
Bromine	0.1	12.	0.8	Euler
Cadmium sulphate	2.0	19.04	0.246	Seitz
Calcium chloride	2.0	10.	0.68	Schuhmeister
Chlorine	0.1	12.	1.22	Euler
Copper sulphate	0.1	17.	0.39	Thovert
Formic acid	1.0	12.	0.97	Abegg
Glycerine	0.1	10.14	0.357	Heimbrodt
	0.2	10.1	3.55	Heimbrodt
	1.0	10.14	0.339	Heimbrodt
Hydrochloric acid	0.1	19.2	2.21	Thovert
	1.0	12.	2.09	Arrhenius
	2.0	12.	2.21	Arrhenius
Iodine	0.1	12.	(0.5)	Euler
Magnesium sulphate	1.0	7.	0.30	Scheffer
Nitric acid	0.1	19.5	2.07	Thovert
Potassium bromide	1.0	10.	1.13	Schuhmeister
carbonate	3.0	10.	0.60	Schuhmeister
chloride	0.1	17.5	1.38	Thovert
chloride	4.0	10.	1.27	Schuhmeister
hydrate	0.1	13.5	1.72	Thovert
	1.0	12.	1.72	Arrhenius
	3.0	12.	1.89	Arrhenius
Silver nitrate	0.1	12.	0.985	Thovert
Sodium acetate	0.2	12.	0.67	Kawalki
chloride	0.1	15.0	0.94	Thovert
	0.2	15.0	0.94	Thovert
	1.0	15.0	0.94	Thovert
	1.0	14.3	0.964	Heimbrodt
hydrate	1.0	12.	1.11	Thovert
iodide	1.0	10.	0.80	Schuhmeister
	2.0	10.	0.90	Schuhmeister
Sugar	1.0	12.	0.254	Arrhenius
Sulphuric acid	1.0	12.	1.12	Arrhenius
	2.0	12.	1.16	Arrhenius
Urea	0.1	14.8	0.97	Heimbrodt
	0.2	14.8	0.969	Heimbrodt
Zinc acetate	2.0	18.05	0.210	Seitz
	2.0	0.04	0.120	Seitz
sulphate	1.0	14.8	0 236	Seitz

OSMOTIC PRESSURE OF AQUEOUS SOLUTIONS

FOR A MEMBRANE OF FERROCYANIDE OF COPPER

Dissolved Substance.	Gms. substance in 1 cm. sol.	Temp. ° C.	Pressure, cm. Hg.	Observer.
Glycerine	.00199	0	36.7	
Gum arabic	0.0099	15.5	7.0	Pfeffer
Gum arabic	0.164	15.6	119.3	Pfeffer
Phenol (carbolic acid)	.00127	0	23.3	Naccari
	Gm.-mol. substance per gm. sol.		Pressure in atm.	
Glucose	.0001	10.2	2.39	Morse, 1911
	.0005	10.2	11.55	Morse, 1911
	.0010	10.0	23.80	Morse, 1911
Saccharose (cane sugar)	.0001	10.0	2.50	Morse, 1911
	.0005	10.0	12.30	Morse, 1911
	.0010	10.0	25.69	Morse, 1911
	Gm.-mol. substance in 1 ccm. sol.			
Potassium carbonate	.00005	15	1.17	Adie, 1891
ferrocyanide	.00005	15	3.44	Adie, 1891
nitrate	.00005	15	1.56	Adie, 1891
Sodium citrate (acid)	.00005	15	4.32	Adie, 1891

COEFFICIENT OF THERMAL EXPANSION

LINEAR

The coefficient given is the increase in length per unit length (measured at 0° C.) per degree Centigrade.

Substance	Temp. °C.	Coefficient $\times 10^{-6}$	Observer
Aluminum	−191 to +16	18.35	Henning, 1907
	20	25.5	Voigt, 1893
	40	23.13	Fizeau, 1869
	600	31.50	Chatelier
99.95%	20–100	23.8	Hidnert, 1925
	20–300	25.7	"
	20–600	28.7	"
commercial	20–100	24.0	"
	20–300	26.7	"
	20–600	28.7	"
Aluminum-bronze	20	17.0	National Physical Laboratory
Aluminum-beryllium alloy			
10% Be	20–100	21.4	Hidnert & Sweeney, 1927
	20–300	23.3	" "
	20–500	25.4	" "
32.7% Be	20–100	17.9	" "
	20–300	20.6	" "
	20–500	22.3	" "
Aluminum-copper alloy			
10% Cu	20–100	22.4	Hidnert, 1925
	20–300	28.3	
	20–500	27.7	
Aluminum-silicon alloy 10% Si	20–100	21.1	
	20–300	22.9	
Aluminum-zinc alloy 12% Zn	20–100	24.9	
	20–300	28.1	
97% Zn	20–100	27.5	
	20–200	29.6	
Antimony	−180 to +13	10.23	Gruneisen, 1910
	20	12.	Fizeau, 1869
	15–101	10.88	Gruneisen, 1910
parallel to axis	10–90	17.30	Fizeau, 1869
perpendicular to axis	10–90	8.28	"
Arsenic	10–90	3.86	"
*Bakelite-dilecto	20–60	22.	Souder & Hidnert, 1919
micarta 32X	25–50	33.	" "
Beryllium 98.9%	20–100	12.3	Hidnert, 1925
	20–300	14.0	"
	20–700	16.8	"
Bismuth	−180 to +15	12.98	
	19–101	13.45	
parallel to axis	10–90	15.37	
perpendicular to axis	10–90	10.84	
Brass			
cast	0–100	18.75	Smeaton
wire	0–100	19.30	"
66Cu, 34Zn	20	18.9	National Physical Laboratory

* See Scientific Paper of Bureau of Standards No. 352.

COEFFICIENT OF THERMAL EXPANSION (Continued)

LINEAR

Substance	Temp. °C.	Coefficient	Observer
Primer gilding 97Cu, 2.97Zn....	25–100	16.9	
.01Pb, .02Fe, cold rolled	25–300	17.7	
cast	25–100	17.2	
commercial bronze 90.26Cu.....	25–100	17.5	
9.7Zn, .01Pb, .03Fe	25–300	18.1	
cold rolled			
cast	25–100	17.4	
Low brass 80.02Cu	25–100	18.0	
19.89Zn, .05Pb, .03Fe	25–300	19.1	
cold rolled			
cast	25–100	17.9	
Spring brass, 72.02Cu	25–100	18.5	
27.95Zn, .01Pb, .02Fe	25–300	19.8	Hidnert, 1921
cold rolled			Scientific Paper No. 410
cast	25–100	18.3	Bureau of Standards
Commercial brass, 64.81Cu.....	25–100	19.0	
34.92Zn, .24Pb, .03Fe	25–300	20.2	
cold rolled			
cast	25–100	18.9	
Leaded bronze 88.3Cu	25–100	17.5	
10.Zn, 1.68Pb, .02Fe	25–300	18.3	
cold rolled			
cast	25–100	17.6	
Free turning rod 62.33Cu.....	25–100	19.1	
35.04Zn, 2.57Pb, .06Fe	25–300	20.4	
cold rolled			
cast	25–100	19.0	
Brick	.....	9.5	National Physical Laboratory
Bronze			
3Cu, 1Sn	16.6–100	18.44	Daniell
	16.6–350	21.16	"
	16.6–957	17.37	"
93.5Cu, 6.5Sn	16–100	36.5	Bein, 1912
90Cu, 10Sn	0–900	22.0	Le Chatelier, 1889
80Cu, 20Sn	0–800	27.0	" "
70Cu, 30Sn	0–700	29.5	" "
phosphor			
97, 6Cu, 2Sn, 0.2P	0–85	16.8	Mean
Cadmium	−183 to +14	44.6	Gruneisen, 1901
	20	28.8	Matthiessen, 1866
	0–100	31.59	"
	10–90	29.39	Fizeau
	315	31.6	Vicentini & Omodie
Calcite, parallel to axis	0–85	25.14	Benoit, 1888
perpendicular to axis	0–85	5.58	"
Caoutchouc	.....	65.7–68.6	Various
	17–25	77.0	Kohlrausch
Carbon			
diamond	40	1.18	Fizeau, 1869
gas carbon	40	5.40	"
graphite	40	7.86	"
Celluloid	20–70	109.	Souder & Hidnert, 1919
Cement and concrete	.....	10.–14.	Fizeau
Cobalt	40	12.36	"
*Condesite (No. 100)	16–79	44.0	Souder & Hidnert, 1919
(No. 123)	18–56	20.0	" "
Constantan	4–29	15.23	.....
60Cu, 40Ni	20	17.0	National Physical Laboratory

* See Scientific Paper Bureau of Standards No. 352.

COEFFICIENT OF THERMAL EXPANSION (Continued)

LINEAR

Substance	Temp. °C.	Coefficient	Observer
		$\times 10^{-6}$	
Constantan	−191 to +16	12.02	Henning, 1907
	0–38	14.48	Guillaume, 1896
	0–500	14.81	Holborn & Day, 1900
Copper	−191 to +16	14.09	Henning, 1907
	25–100	16.8	Hidnert, 1921
electrolytic	25–300	17.8	"
	0–625	16.07	Dittenberger, 1902
Diamond, *see Carbon*			
Duralumin, cast	20–100	23.6	Hidnert, 1925
	20–300	26.0	"
	20–500	27.3	"
cold rolled	20–100	23.7	"
	20–300	26.4	"
	20–500	27.3	"
Ebonite	25–35	84.2	Kohlrausch
Emerald, parallel to axis	0–85	1.35	Benoit
perpendicular to axis	0–85	1.00	
Fluor spar, CaF_2	0–100	19.5	Pfaff
Formica	20–60	30.0	Souder & Hidnert, 1919
Galena		19.9	
German silver	0–100	18.36	Pfaff
60Cu, 15Ni, 25Zn			
Glass			
tube	0–100	8.33	Fizeau
soft		8.5	Schott
hard		9.7	"
plate	0–100	8.91	Lavoisier & Laplace
crown	0–100	8.97	" "
flint	50–60	7.88	Pulfrich
Jena thermometer			
16^{III} normal	0–100	8.1	Schott
59^{III}	0–100	5.8	"
59^{III}	−191 to +16	4.24	Henning, 1907
Gold	−183 to +16	13.2	Gruneisen, 1910
	16–100	14.3	"
Gold-copper	0–100	15.52	Matthiessen
2Au, 1Cu			
Gold-platinum	0–100	15.23	"
2Au, 1Pt.			
Granite		8.3	
Gun Metal		18.3	National Physical Laboratory
Gutta percha		198.3	Russner, 1882
Hard Rubber	20–60	80.	Souder & Hidnert, 1919
Ice	−20 to −1	51.0	
	−10 to 0	50.7	Vincent, 1902
	40	41.7	Fizeau, 1869
Indium			
Invar, *see Nickel steel*			
Iodine	−188 to 16	83.7	Dewar, 1902
Iridium	−183 to +19	5.71	Gruneisen, 1910
Iron	−190 to +17	9.07	Henning, 1907
soft	40	12.10	Fizeau, 1869
cast	40	10.61	"
cast	−190 to +16	8.50	Henning, 1907
wrought	−18 to +100	11.40	Andrews
steel	40	13.22	Fizeau, 1869
steel, annealed	40	10.95	"
steel, 1.2% C	0–100	10.5	Le Chatelier, 1899
"	100–200	11.5	"
"	200–300	13.	"

COEFFICIENT OF THERMAL EXPANSION (Continued)

LINEAR

Substance	Temp. °C.	Coefficient	Observer
Iron, steel	300–400	15.	Le Chatelier, 1899
"	400–500	14.	"
"	500–600	16.	"
"	600–700	16.	"
"	above 900	29.	"
Lead	−183 to +14	27.08	Gruneisen, 1910
	18–100	29.40	"
Lead-tin	0–100	25.08	Smeaton
2Pb, 1Sn			
Magnesium	−183 to +15	21.40	Gruneisen, 1910
	18–100	26.08	"
	20–100	26.0	Hidnert & Sweeney, 1928
	20–200	27.9	" "
	20–500	29.8	" "
cast	20–100	26.96	C. D. H., 1917
wrought	20–100	26.73	"
Magnalium	0–13	22.	Guillaume, 1902
96Al, 4Mg,			
86Al, 14Mg	12–39	23.8	Stadhagen, 1901
Marble	15–100	11.7	Frohlich
* Rutland blue (Vt)			
heated in air	25–100	15.	Souder & Hidnert, 1919
	100–200	23.	" "
	200–300	28.	" "
cooled	300–200	15.	" "
	200–100	9.	" "
	100–25	4.	" "
* Silver gray (Ga.)			
cooled	25–0	13.	" "
	0 to −60	10.	" "
heated in air	20–65	1.0	" "
cooled	65–20	.5	" "
Masonry	.....	4.–7.	.....
Mercury	−183 to −39	30.	Dewar, 1902
	−78 to −38	41.	Grunmach, 1901
Molybdenum	25–100	4.9	Hidnert & Gero, 1924
	25–500	5.5	" "
Monel metal	25–100	13.7–14.5	Souder & Hidnert
	25–300	14.9–15.2	" "
	25–600	15.9–16.7	" "
Nickel	−191 to +16	10.12	Henning, 1907
	40	12.79	Fizeau
	16–250	13.97	Holborn & Day, 1901
	375–1000	13.46	Holborn & Day, 1901
commercial	25–100	12.9	Souder & Hidnert, 1921
		13.5	
Nickel steel			
10% Ni	20	13.0	Nat. Phys. Lab.
20	20	19.5	" " "
30	20	12.	" " "
36 (Invar)	20	.9	" " "
40	20	6.0	" " "
50	20	9.7	" " "
80	20	12.5	" " "
Osmium	40	6.57	Fizeau
Palladium	40	11.76	"
	0–100	11 04	Matthiessen
Paraffine	0–16	106.6	Rodwell
	16–38	130.3	"
	38–49	477.1	"
Phosphorous	0–44	124.	Laduc, 1891

* For full details and data on other samples see Scientific Paper 352 Bureau of Standards.

COEFFICIENT OF THERMAL EXPANSION (Continued)

LINEAR

Substance	Temp. °C.	Coefficient	Observer
		$\times 10^{-6}$	
Phosphor bronze, *see Bronze*			
Platinum	40	8.99	Fizeau
Platinum iridium	40	8.84	"
10 Pt. 1Ir	0–100	15.23	Matthiessen
Platinum silver			
33Pt, 67Ag	20–790	4.13	Braun
Porcelain	0–100	3.1	Holborn & Gruneisen
Berlin	0	2.5	Tutton, 1902
Bayeux	1000–1400	5.53	Deville & Troost
Clay .50, flint .15			
beryl .35	20–200	1.6	Souder & Hidnert, 1919
	400–540	3.6	" "
clay .80, feldepar	20–200	2.9	" "
.85, whiting .015	200–400	4.0	" "
clay .70, feldepar	20–200	3.3	" "
.19, flint .095, whiting 1.5	200–400	4.0	" "
clay .50, feldepar	20–200	4.7	" "
.16, flint .34	200–400	4.6	" "
Quartz (crystal)	−190 to +16	5.21	Scheel
parallel to axis	0–80	7.97	Benoit, 1888
perpendicular to axis	0–80	13.37	"
fused	−191 to +16	.256	Henning, 1907
	0–30	.42	Chappius, 1903
	0–100	.50	Scheel, 1907
	0–800	.546	Randall, 1910
	0–1200	.585	"
Rhodium	40	8.5	Fizeau
Rock salt	40	40.40	"
Rubidium	2–17	86.2	Elsa Deuss, 1911
Ruthenium	40	9.63	Fizeau
Sandstone	20	7.–12.	.....
Selenium	−180 to 0	37.2	Dorsey, 1908
	40	36.80	Fizeau
	40	7.63	"
Silicon			
Silver	−191 to +16	17.04	Henning, 1907
	20	18.8	Voigt, 1893
Slate	20	6.–10.	.....
Solder, *see Lead-tin*			
Speculum metal	20	19.3	Smeaton
68Cu, 32Sn			
Sodium	−188 to +17	62.2	Dewar, 1902
Stainless steel			
hardened	20–100	9.6	Souder & Hidnert, 1921
	20–200	9.8	" "
	20–600	11.2	" "
annealed	20–100	10.3	" "
	20–200	10.7	" "
	20–600	12.1	" "
Stellite, soft	20–100	14.1	Souder & Hidnert, 1921
80Co, 20Cr	20–300	15.2	" "
	20–600	16.1	" "
hard, 55Co, 40Cr	20–100	13.4	" "
3W, 2C	20–300	15.0	" "
	20–600	16.5	" "
"No. 2" 55Co, 35Cr	20–100	11.0	" "
10W	20–300	12.4	" "
	20–600	13.6	" "
Sulphur, crystal	40	64.13	Fizeau, 1869
Tellurium	40	16.75	Fizeau, 1869

COEFFICIENT OF THERMAL EXPANSION (Continued)

LINEAR

Substance	Temp. °C.	Coefficient	Observer
		$\times 10^{-6}$	
Thallium	40	30.21	Fizeau, 1869
Thorium	0–100	12.3	Rentschler, Marden, 1925
Tin	−183 to +16	22.57	Grueneisen, 1910
	18–100	26.92	"
Topaz, axis a	0–100	8.32	Pfaff
" b	0–100	8.36	"
" c	0–100	4.72	"
Tourmaline			
parallel to axis	0–100	9.37	"
perpendicular to axis	0–100	7.73	"
Tungsten 99.978%	−100–0	4.2	Hidnert & Sweeney, 1925
	0–100	4.3	" "
	0–300	4.5	" "
	0–500	4.6	" "
	1000–2000	6.1	Worthen, 1916
filament	17–254	19.52	Daniell
Type metal	0–18	63.60	Mayer
Vulcanite			
Wood			
parallel to fiber			
ash	0–100	9.51	Glatzel
beech	2–34	2.57	Villari
chestnut	2–34	6.49	"
elm	2–34	5.65	"
mahogany	2–34	3.61	"
maple	2–34	6.38	"
oak	2–34	4.92	"
pine	2–34	5.41	"
walnut	2–34	6.58	"
across fiber			
beech	2–34	61.4	"
chestnut	2–34	32.5	"
elm	2–34	44.3	"
mahogany	2–34	40.4	"
maple	2–34	48.4	"
oak	2–34	54.4	"
pine	2–34	34.1	"
walnut	2–34	48.4	"
Zinc	−180 to 0	26.4	Dorsey, 1908
	10–100	26.28	Thiesen, 1895

THERMAL EXPANSION OF GLASSES

The following table gives the mean coefficient of linear expansion for various types of glass as determined by Peters and Cragoe of the Bureau of Standards. 1920.

Glass sample	Temp. interval	Coefficient	Temp. interval	Coefficient
1 Barium flint	22–494	0.088	519–550	0.331
4 Plate, American	20–508	.108	540–560	.401
6 German	21–496	.099	564–589	.477
7 French	21–513	.094	597–613	.424
8 Light crown	24–422	.104	494–507	.548
10 Borosilicate crown	22–498	.090	539–562	.393
11 Barium crown	23–499	.090	589–610	.649
12 Medium flint	23–402	.097	452–478	.396
13 Light flint	22–451	.088	494–512	.347
16 Commercial glass	23–445	.107	510–534	.309
20 McBeth-Evans flask	22–449	.069	567–586	.454
21 Pyrex	21–471	.036	552–571	.151
22 Schott-Genossen flask	19–414	.056	540–562	.404
23 Soda tubing	21–372	.120	506–525	.234
24 Lead tubing	21–338	.091	464–483	.236
26 Fluorite tubing	22–364	.098	510–551	.284
29 Fusing in glass, German	23–383	.090	456–481	.283
30 Fusing in glass, Corning	22–376	.083	460–485	.258

More complete data, including the composition of the samples named above, will be found in Scientific Paper No. 393, Bureau of Standards.

EQUATION FOR THE LINEAR EXPANSION OF SOLIDS

If l_0 is the length at 0° C. the length at t° C. is $l_t = l_0 (1 + \alpha t + \beta t^2)$.

The table gives the values of these coefficients.

Substance.	Temp. limits. ° C.	α.	β.	Observer.
Aluminum	10–90	$.2221 \times 10^{-4}$	$.114 \times 10^{-7}$	Fizeau
Brass	10–90	.1781	.098	Fizeau
Copper	10–90	.1596	.102	Fizeau
Gold	10–90	.1410	.042	Fizeau
Iron, pure	0–38	.1145	.071	Guillaume
Lead	10–90	.2829	.120	Fizeau
Nickel	0–38	.1255	.057	Guillaume
Platinum	0–1000	.0868	.013	Holborn and Valentine
Silver	10–90	.1862	.074	Fizeau
Tin	10–90	.2094	.175	Fizeau
Zinc	10–90	.2969	−.0635	Fizeau

CUBICAL EXPANSION OF SOLIDS

The coefficient of cubical expansion for a solid is approximately three times the linear coefficient.

The experimental values for various solids are given in the following table. The coefficient is the increase in volume per unit volume per degree Centigrade.

Substance.	Temp. ° C.	Coefficient.	Observer.
Antimony	0–100	0.3167×10^{-4}	Matthieson
Bismuth	.....	0.4000	Kopp
Diamond	40	0.0354	Fizeau
Fluor spar	14–47	0.6235	Kopp
Glass, white tube	0–100	0.2648	Regnault
green tube	0–100	0.2299	Regnault
Jena	0–100	0.2533	Reichsanstalt
Ice	−20 to −1	1.1250	Brunner
Iceland spar	50–60	0.1447	Pulfrich
Iron	0–100	0.3550	Dulong and Petit
Porcelain	0–100	0.1080	Deville and Troost
Quartz	50–60	0.3530	Pulfrich
Rock salt	50–60	1.2120	Pulfrich

CUBICAL EXPANSION OF LIQUIDS

The table gives the mean coefficient of cubical expansion for the range 0–100° C. and the values of the quantities α, β and γ in the equation $V_t = V_0 (1 + \alpha t + \beta t^2 + \gamma t^3)$.

(From Smithsonian Tables.)

Liquid.	Temp. Range ° C.	Mean coef. 0-100° C.	α	β	γ	Observer.
Acetic acid	16–107	.001433	1.0630×10^{-3}	0.1264×10^{-6}	1.0876×10^{-9}	Zander
Acetone	0–54	1616	1.3240	3.8090	0.8798	Zander
Alcohol:						
amyl	−15 to +80	.....	0.8900	0.6573	1.1846	Pierre
ethyl, sp.gr. .8095	0–80	.....	1.0414	0.7836	1.7168	Kopp
ethyl, 50% by volume	0–39	.....	0.7450	1.850	0.730	Recknagel
ethyl, 30% by volume	18–39	.....	0.2928	17.900	11.87	Recknagel
methyl	−38 to +70	1433	1.1856	1.5649	0.9111	Pierre
Benzene	11–81	1385	1.1763	1.2775	0.8065	Kopp
Bromine	− 7 to +60	1168	1.0382	1.7114	0.5447	Pierre
Calcium chloride:						
$CaCl_2$, 5.8% solution	18–25	0506	0.0788	4.2742	.....	Decker
$CaCl_2$, 40.9% solution	17–24	0510	0.4238	0.8571	.....	Decker
Carbon disulphide	−34 to +60	1468	1.1398	1.3706	1.9122	Pierre
Chloroform	0–63	1399	1.1071	4.6647	1.7433	Pierre
Ether	−15 to +38	2150	1.5132	2.3592	4.0051	Pierre
Glycerine	.....	0534	0.4853	0.4895	.....	Emo
Hydrochloric acid:						
$HCl + 6.25H_2O$	0–30	0489	0.4460	0.430	.....	Marignac
$HCl + 50H_2O$	0–30	0933	0.0625	8.710	.....	Marignac

CUBICAL EXPANSION OF LIQUIDS (Continued)

Liquid.	Temp. Range ° C.	Mean coef. 0-100° C.	α	β	γ	Observer.
Mercury	24–299	.....	0.18182×10^{-3}	0.00078×10^{-6}	.....	Scheel
Olive oil	.....	.000742	0.6821	1.1405	$-.539\times10^{-8}$	Spring
Potassium chloride:						
KCl, 2.5% solution	.....	0572	.....	.....	.....	Decker
KCl, 24.3% solution	.....	0477	.....	.....	.....	Decker
Potassium nitrate:						
KNO_3, 5.3% solution	.....	0539	.....	.....	.....	Nicol
KNO_3, 21.9% solution	.....	0577	.....	.....	.....	Nicol
Phenol, C_6H_6O	36–157	0899	0.8340	0.1073	0.4446	Pinette
Petroleum, sp.gr. 0.8467	24–120	1039	0.8994	1.396	.....	Frankenheim
Sodium chloride, NaCl, 1.6% solution	.....	1067	0.0213	10.462	.....	Marignac
Sodium sulphate, Na_2SO_4, 24% solution	10–40	0611	0.3599	2.516	.....	Marignac
Sodium nitrate, $NaNO_3$, 36.2% solution	20–78	0627	0.5408	1.075	.....	Nicol
Sulphuric acid:						
H_2SO_4	0–30	0489	0.5758	0.864	.....	Marignac
$H_2SO_4+50H_2O$	0–30	0799	0.2835	5.160	.....	Marignac
Turpentine	−9 to +106	1051	0.9003	1.959	.....	Kopp
Water	0–33	.....	−.0643	8.505	6.790	Scheel

COEFFICIENTS OF EXPANSION OF GASES AT CONSTANT PRESSURE

Change in volume per unit volume per degree Centigrade.

(From Smithsonian Tables.)

Gas.	Temp. ° C.	Pressure in cm. of mercury.	Coefficient.	Observer.
Acetylene	0	76.	.003772	Leduc, 1912
Acetylene	0–100	76.	3739	Leduc, 1912
Air	0–100	76.	3670	Regnault, 1842
Air	0–100	100.1	36728	Chappuis, 1903
Ammonia	0	76.	3860	Leduc, 1912
Ammonia	0–100	76.	3800	Leduc, 1912
Carbon dioxide	0	76.	3751	Leduc, 1912
Carbon dioxide	0–100	76.	3723	Leduc, 1912
Carbon dioxide	0–20	51.8	37128	Chappuis, 1903
Carbon dioxide	0–40	51.8	37100	Chappuis, 1903
Carbon dioxide	0–100	51.8	37073	Chappuis, 1903
Carbon dioxide	0–20	99.8	37602	Chappuis, 1903
Carbon dioxide	0–100	99.8	37410	Chappuis, 1903
Carbon dioxide	0–20	137.7	37972	Chappuis, 1903
Carbon dioxide	0–100	137.7	37703	Chappuis, 1903
Carbon dioxide	0–7.5	2621.	1097	Baly-Ramsay, 1894
Carbon dioxide	64–100	2621.	6574	Baly-Ramsay, 1894
Carbon monoxide	0–100	76.	3669	Regnault, 1842
Chlorine	0	76.	3900	Leduc, 1912
Chlorine	0–100	76.	3830	Leduc, 1912
Cyanogen	0	76.	396	Leduc, 1912
Cyanogen	0–100	76.	387	Leduc, 1912
Hydrochloric acid	0	76.	3770	Leduc, 1912
Hydrochloric acid	0–100	76.	3734	Leduc, 1912
Hydrogen	0–100	100.0	36600	Chappuis, 1903
Hydrogen	0–100	200. atm	332	Amagat, 1890
Hydrogen	0–100	400. atm	295	Amagat, 1890
Hydrogen	0–100	600. atm	261	Amagat, 1890
Hydrogen	0–100	800. atm	242	Amagat, 1890
Nitrogen	0	76.	3673	Leduc, 1912
Nitrogen	0–100	76.	3671	Leduc, 1912
Nitrous oxide	0–100	76.	3719	Regnault, 1842
Oxygen	0–100	100. atm	486	Amagat
Oxygen	0–100	200. atm	534	Amagat
Oxygen	0–100	400. atm	459	Amagat
Oxygen	0–100	600. atm	357	Amagat
Oxygen	0–100	800. atm	288	Amagat
Oxygen	0–100	1000. atm	241	Amagat
Sulphur dioxide	0–100	76.	3903	Regnault, 1842
Sulphur dioxide	.....	98.	3980	Regnault, 1842
Water vapor	0–119	76.	4187	Hirn, 1862
Water vapor	0–141	76.	4189	Hirn, 1862
Water vapor	0–162	76.	4071	Hirn, 1862
Water vapor	0–200	76.	3938	Hirn, 1862
Water vapor	0–247	76.	3799	Hirn, 1862

COEFFICIENT OF EXPANSION OF GASES AT CONSTANT VOLUME

Change in pressure per unit pressure per degree Centigrade.

(From Smithsonian Tables.)

Gas.	Temp. ° C.	Pressure cm. of Hg.	Coefficient.	Observer.
Acetylene	0	76.	.003741	Leduc, 1912
Acetylene	0–100	76.	3726	Leduc, 1912
Air	.....	.6	37666	Meleander, 1890–92
Air	.....	1.3	37127	Meleander, 1890–92
Air	.....	10.0	36630	Meleander, 1890–92
Air	.....	25.4	36580	Meleander, 1890–92
Air	.....	75.2	36660	Meleander, 1890–92
Air	0–100	100.1	36744	Chappuis, 1903
Air	.....	76.0	36650	Regnault, 1842
Air	.....	200.0	36903	Regnault, 1842
Air	.....	2000.	38866	Regnault, 1842
Air	.....	10000.	4100	Regnault, 1842
Air	0	76.	3800	Leduc, 1912
Ammonia	0–100	76.	3770	Leduc, 1912
Argon	.....	51.7	3668	Keunen-Randall, 1896
Carbon dioxide	0–20	51.8	36985	Chappuis, 1903
Carbon dioxide	0–40	51.8	36972	Chappuis, 1903
Carbon dioxide	0–100	51.8	36981	Chappuis, 1903
Carbon dioxide	0–20	99.8	37335	Chappuis, 1903
Carbon dioxide	0–100	99.8	37262	Chappuis, 1903
Carbon dioxide	0–100	100.0	37248	Chappuis, 1892
Carbon dioxide	0	76.	3724	Leduc, 1912
Carbon dioxide	0–100	76.	3714	Leduc, 1912
Carbon monoxide	.....	76.	36667	Regnault, 1842
Cyanogen	0	76.	3870	Leduc, 1912
Cyanogen	0–100	76.	3830	Leduc, 1912
Ethane	0	76.	3780	Leduc, 1912
Ethane	0–100	76.	3750	Leduc, 1912
Helium	.....	56.7	3665	Keunen-Randall, 1896
Hydrochloric acid	.....	76.	3740	Leduc, 1912
Hydrochloric acid	0–100	76.	3721	Leduc, 1912
Hydrogen	0	76.	3663	Leduc, 1912
Hydrogen	0–100	76.	3664	Leduc, 1912
Hydrogen	16–132	.0077	3328	Baly-Ramsay, 1894
Hydrogen	15–132	.025	3623	Baly-Ramsay, 1894
Hydrogen	12–105	.47	3656	Baly-Ramsay, 1894
Hydrogen	0–100	100.0	36626	Chappuis, 1903
Methane	0	76.	3680	Leduc, 1912
Methane	0–100	76.	3678	Leduc, 1912
Nitrogen	0	76.	3672	Leduc, 1912
Nitrogen	0–100	76.	3672	Leduc, 1912
Nitrogen	13–132	.06	3021	Baly-Ramsay, 1894
Nitrogen	9–133	.53	3290	Baly-Ramsay, 1894
Nitrogen	0–20	100.2	36754	Chappuis, 1903
Nitrogen	0–100	100.2	36744	Chappuis, 1903
Oxygen	0	76.	3673	Leduc, 1912
Oxygen	0–100	76.	3672	Leduc, 1912
Oxygen	11–132	.007	4161	Baly-Ramsay, 1894
Oxygen	9–132	.25	3984	Baly-Ramsay, 1894
Oxygen	11–132	.51	3831	Baly-Ramsay, 1894
Oxygen	.....	1.9	36683	Meleander, 1891
Oxygen	.....	18.5	36690	Meleander, 1891
Nitrous oxide	.....	76.	3676	Regnault, 1842
Sulphur dioxide, SO_2	.....	76.	3845	Regnault, 1842

REDUCTION OF GAS VOLUME

VALUES OF (1+at) FOR TEMPERATURES FROM 0 TO 120° C.

T	0	1	2	3	4	5	6	7	8	9
00	1.0000	1.0037	1.0073	1.0110	1.0147	1.0183	1.0220	1.0257	1.0294	1.0330
10	1.0367	1.0404	1.0440	1.0477	1.0514	1.0550	1.0587	1.0624	1.0661	1.0697
20	1.0734	1.0771	1.0807	1.0844	1.0881	1.0917	1.0954	1.0991	1.1028	1.1064
30	1.1101	1.1138	1.1174	1.1211	1.1248	1.1284	1.1321	1.1358	1.1395	1.1431
40	1.1468	1.1505	1.1541	1.1578	1.1615	1.1651	1.1688	1.1725	1.1762	1.1798
50	1.1835	1.1872	1.1908	1.1945	1.1982	1.2018	1.2055	1.2092	1.2129	1.2165
60	1.2202	1.2239	1.2275	1.2312	1.2349	1.2385	1.2422	1.2459	1.2496	1.2532
70	1.2569	1.2606	1.2642	1.2679	1.2716	1.2752	1.2789	1.2826	1.2863	1.2899
80	1.2936	1.2973	1.3009	1.3046	1.3083	1.3119	1.3156	1.3193	1.3230	1.3266
90	1.3303	1.3340	1.3376	1.3413	1.3450	1.3486	1.3523	1.3560	1.3597	1.3633
100	1.3670	1.3707	1.3743	1.3780	1.3817	1.3853	1.3890	1.3927	1.3964	1.4000
110	1.4037	1.4074	1.4110	1.4147	1.4184	1.4220	1.4257	1.4294	1.4331	1.4367
120	1.4404									

VALUES OF H/760 FOR PRESSURES FROM 700 TO 780 MM. OF MERCURY.

H	0	1	2	3	4	5	6	7	8	9
700	0.9211	0.9224	0.9237	0.9250	0.9263	0.9276	0.9289	0.9303	0.9316	0.9329
710	0.9342	0.9355	0.9368	0.9382	0.9395	0.9408	0.9421	0.9434	0.9447	0.9461
720	0.9474	0.9487	0.9500	0.9513	0.9526	0.9539	0.9553	0.9566	0.9579	0.9592
730	0.9605	0.9618	0.9632	0.9645	0.9658	0.9671	0.9684	0.9697	0.9711	0.9724
740	0.9737	0.9750	0.9763	0.9776	0.9789	0.9803	0.9816	0.9829	0.9842	0.9855
750	0.9868	0.9882	0.9895	0.9908	0.9921	0.9934	0.9947	0.9961	0.9974	0.9987
760	1.0000	1.0013	1.0026	1.0039	1.0053	1.0066	1.0079	1.0092	1.0105	1.0118
770	1.0132	1.0145	1.0158	1.0171	1.0184	1.0197	1.0211	1.0224	1.0237	1.0250
780	1.0263									

SPECIFIC HEAT OF WATER AND MERCURY

Values for water from 0–100° C. are the mean of various determinations including Calendar and Blonsfield, 1912; above 100, Regnault's values recomputed by Guillaume, 1912.

Values for mercury 0–80° C. due to Barnes and Cooke; 90–140°, mean of Winkelmann, Naccari and Milthaler; above 140°, mean of Naccari and Milthaler.

Specific heat in normal calories (15° C.).

Temp. ° C.	Water.	Mercury.	Temp. ° C.	Water.	Mercury.
0	1.00874	.03346	80	1.00239	.03284
5	1.00477	.03340	85	1.00329	
10	1.00184	.03335	90	1.00433	.03277
15	1.00000	.03330	95	1.00534	
20	0.99859	.03325	100	1.00645	.03269
25	0.99765	.03320	110	1.0116	.03262
30	0.99745	.03316	120	1.0144	.03255
35	0.99743	.03312	130	1.0174	.03248
40	0.99761	.03308	140	1.0206	.03241
45	0.99790		150	1.0240	.0324
50	0.99829	.03300	160	1.0275	
55	0.99873		170	1.0313	.0322
60	0.99934	.03294	180	1.0353	
65	1.00001		190	1.0395	.0320
70	1.00077	.03289	200	1.0439	
75	1.00158				

SPECIFIC HEAT OF WATER

Temperatures on the normal (hydrogen) scale: specific heat in normal calories (15°)

Ice

Temp. C.	Specific Heat.	Observer.	Temp. C.	Specific Heat.	Observer.
−252 to −188	0.146	Dieterici, 1903	−160	0.230	Nernst, 1910
			−140	.262	Nernst, 1910
−188 to −78	.285	Dieterici, 1903	−100	.325	Nernst, 1910
			−60	.392	Nernst, 1910
−78 to −18	.463	Dieterici, 1903	−20	.480	Nernst, 1910
			−10	.53	Nernst, 1910
−200	.168	Nernst, 1910	−21 to 0	.505	Person, 1847
−180	.199	Nernst, 1910			

Water Below 0° C.

−6	1.0119	Martinetti, 1890	−2	1.0097	Martinetti, 1890
−5	1.0113	Martinetti, 1890	−1	1.0092	Martinetti, 1890
−4	1.0105	Martinetti, 1890	−5	1.0155	Barnes, 1902
−3	1.0102				

Water 0–100° C.

Temp. ° C.	Barnes, 1902.	Dieterici,* 1905.	Callendar, 1912.	Blousfield, 1912.	Mean.**
0	.....	1.0089	1.00934	1.0070	1.00874
5	1.00502	1.0051	1.00494	1.0039	1.00477
10	1.00201	1.0021	1.00187	1.0016	1.00184
15	1.00000	1.0000	1.00000	1.0000	1.00000
20	.99864	.9987	.99878	.9991	.99859
25	.99775	.9983	.99800	.9989	.99765
30	.99725	.9983	.99755	.9990	.99745
35	.99708	.9984	.99734	.9997	.99743
40	.99708	.9984	.99734	1.0006	.99761
45	.99730	.9989	.99749	1.0018	.99790
50	.99768	.9994	.99779	1.0031	.99829
55	.99818	.9998	.99820	1.0045	.99873
60	.99880	1.0005	.99872	1.0058	.99934
65	.99940	1.0013	.99933	1.0070	1.00001
70	1.00007	1.0022	1.00003	1.0083	1.00077
75	1.00072	1.0032	1.00081	1.0088	1.00158
80	1.00141	1.0041	1.00166	1.0091	1.00239
85	1.00208	1.0053	1.00260	.....	1.00329
90	1.00275	1.0066	1.00357	.....	1.00433
95	1.00341	1.0080	1.00462	.....	1.00534
100	1.00410	1.0095	1.00574	.....	1.00645

* Temperature by air thermometer. ** Mean of observations by Rowland, Bartoli and Stracciati, Griffiths, Barnes, Dieterici, and Callendar.

SPECIFIC HEAT OF WATER (Continued)

Water Above 100° C.

Temp. ° C.	Regnault, 1847, recomputed by Guillaume, 1912.	Dieterici, 1905.	Temp. ° C.	Dieterici, 1905.
110	1.0116	1.0126	210	1.0695
120	1.0144	1.0168	220	1.0769
130	1.0174	1.0214	230	1.0857
140	1.0206	1.0255	240	1.0939
150	1.0240	1.0310	250	1.1035
160	1.0275	1.0359	260	1.1126
170	1.0313	1.0422	270	1.1230
180	1.0353	1.0479	280	1.1329
190	1.0395	1.0550	290	1.1442
200	1.0439	1.0616	300	1.1549

MECHANICAL EQUIVALENT OF HEAT

Observer.	Ergs per calorie (15°).	Observer.	Ergs per calorie (15°).
Joule, 1878.....	4.177×10^7	Callendar and Barnes, 1900	4.186×10^7
Rowland, 1879.....	4.188	Dieterici, 1905.....	4.1879
Griffiths, 1893.....	4.196	Blousfield, 1912.....	4.1791
Schuster and Gannon, 1898	4.196	Jaeger and Steinwehr, 1921	4.184

Value adopted by the Bureau of Standards: 1 gram-calorie (20°) = 4.183 joules (based on international electrical units).

SPECIFIC HEAT OF ELEMENTS

Element.	Temp. °C.	Specific heat, Cal./gm.	Observer.
Aluminum.....	−240.6	0.0092	Nernst, 1911
	−233.	0.0165	"
	−190.	0.0889	"
	−190 to −82	0.1466	Koref, 1911
	−76 to −1	0.1962	"
	17–100	0.217	Schimpff, 1910
	15–435	0.236	Tilden, 1902
	500	0.274	Bontschew
Antimony.....	−186 to −79	0.0462	Behn, 1900
	−188 to +20	0.0468	Richards & Jackson, 1910
	20	0.0503	Gaede, 1902
	100	0.0513	"
	200	0.0520	Naccari, 1887
	300	0.0537	"
Arsenic, gray, crystal.....	0–100	0.0822	Wigand, 1903
black amor....	0–100	0.0861	"
	−188 to +20	0.0704	Richards & Jackson, 1910
Barium.....	−185 to +20	0.068	Nordmeyer-Bernouli, 1907
Beryllium.....	0–100	0.425	Nilson & Pettersson, 1880
Bismuth.....	−188 to +20	0.0284	Richards & Jackson, 1910
	−79 to +17	0.0285	Schimpff, 1910
	17–100	0.0303	"
liquid	280–360	0.0363	Person
Boron, amor.....	−191 to −78	0.071	Koref, 1911
	−78–0	0.165	"
	0–100	0.307	Moissan & Gautier
	0–234	0.357	" "
Bromine, solid...	−191 to −81	0.070	Koref, 1911
	−78 to −20	0.084	Regnault, 1849
liquid.....	1–32	0.107	Andrews, 1848
Cadmium.....	−186 to −79	0.0498	Behn, 1910
	−79 to +18	0.0537	"
	20	0.0549	Gaede, 1902
	100	0.0566	"
	200	0.0594	Naccari, 1887
	300	0.0617	"
Caesium.....	0–26	0.048	Eckardt & Graefe, 1900
Calcium.....	−185 to +20	0.157	Nordmeyer & Bernouli, 1906
	0–20	0.145	Bernini, 1907

SPECIFIC HEAT OF ELEMENTS (Continued)

Element.	Temp. °C.	Specific heat, Cal./gm.	Observer.
Calcium	0–157	0.152	Bernini, 1907
Carbon:			
gas carbon....	24–68	0.204	Bettendorff & Wüllner
charcoal.....	0–24	0.165	Weber, 1875
graphite.....	−243	0.005	Nernst, 1911
	−203	0.0175	"
	−188 to −78	0.060	Dewar, 1905
	11	0.160	Weber, 1875
	138	0.254	"
	642	0.445	"
diamond.....	−233	0.0005	Nernst, 1911
	−185	0.0025	"
	−188 to −78	0.019	Dewar, 1905
	−78 to +18	0.079	"
	11	0.113	Weber, 1875
	140	0.222	"
	247	0.303	"
	306	0.441	"
Cerium.....	0–100	0.0448	Hillebrand, 1876
Chlorine, liquid..	0–24	0.226	Knietsch
Chromium.....	−188 to +20	0.0793	Richards & Jackson, 1910
	−79 to +17	0.098	Schimpff, 1910
	17–100	0.110	"
	100	0.112	Adler, 1903
	400	0.133	"
Cobalt.....	−188 to +20	0.0827	Richards & Jackson, 1910
	15–100	0.1035	Tilden, 1900
	15–185	0.1047	" 1902
	300	0.121	Göbl, 1911
	*508	0.145 0.125	" "
	800	0.160	"
	1000	0.184	"
	*1112	0.270 0.170	" "
Copper.....	−253	0.0031	Nernst, 1911
	−213	0.029	"
	−193	0.047	"
	−188 to +20	0.0788	Richards & Jackson, 1910
	−79 to +18	0.0883	Behn, 1900
	20	0.0912	Gaede, 1902
	15–100	0.09305	Bartoli & Stracciati

* Temperatures of Transformation.

SPECIFIC HEAT OF ELEMENTS (Continued)

Element.	Temp. °C.	Specific heat, Cal./gm.	Observer.
Copper:			
	100	0.0942	Gaede, 1900
	200	0.0963	Naccari, 1887
	900	0.1259	Richards, 1893
Didymium	0–100	0.046	Hillebrand, 1876
Gallium, liquid	13–110	0.080	Berthelot, 1878
solid	12–23	0.079	"
Germanium	0–100	0.074	Pettersson-Hedelius, 1881
Glucinium	0–46	0.397	Nilson & Pettersson, 1880
	0–300	0.505	Nilson & Pettersson, 1880
Gold	−188 to −20	0.0297	Richards & Jackson, 1910
	−79 to +17	0.0297	Schimpff, 1910
	0–100	0.0316	Voille, 1877
	17–100	0.031	Schimpff
	0–900	0.0345	Voille, 1879
Hydrogen, liq.	−253	6.0	Dewar, 1901
Indium	−186 to −79	0.0263	Behn, 1900
	−79 to +18	0.0303	"
	18–100	0.0323	"
Iodine	−243	0.031	Nernst, 1911
	−193	0.043	"
	−189 to −76	0.0467	" 1910
	−76–0	0.0516	"
	9–98	0.054	Regnault
liquid	107–180	0.108	Favre & Silbermann, 1863
Iridium	−186 to −79	0.0263	Behn, 1900
	−79 to +18	0.0302	"
	18–100	0.0323	"
	0–900	0.0371	Violle, 1879
Iron	−186 to −79	0.0721	Behn, 1900
	−79 to +18	0.1000	"
	18–100	0.113	"
	300	0.138	Naccari, 1887
	0–650	0.138	Weiss & Beck, 1908
	650	0.195	" "
	850	0.23	" "
cast	20–100	0.1189	Schmitz, 1903
wrought	15–100	0.1152	Nichol, 1881
hard drawn	20–100	0.1146	Hill, 1901
Lanthanum	0–100	0.0448	Hillebrand, 1876

SPECIFIC HEAT OF ELEMENTS (Continued)

Element.	Temp. °C.	Specific heat, Cal./gm.	Observer.
Lead.....	−253	0.0120	Nernst, 1911
	−233	0.0220	"
	−173	0.0275	"
	−192 to +20	0.0293	Schmitz, 1903
	−186 to −79	0.0291	Behn, 1910
	−79 to +18	0.0300	"
	20–100	0.0305	Schmitz, 1903
	100	0.0313	Gaede, 1902
	300	0.0338	Naccari, 1887
liquid.....	360	0.0410	Spring, 1886
Lithium.....	−191 to −80	0.52	Koref, 1911
	−100	0.5997	Laemmel, 1905
	0	0.7951	"
	50	0.9063	"
	100	1.0407	"
	190	1.3745	"
	0–100	1.09	Bernini, 1907
Magnesium.....	−185 to +20	0.222	Nordmeyer-Bernouli, 1907
	−186 to −79	0.189	Behn, 1900
	− 79 to +18	0.233	"
	17–100	0.248	Schimpff, 1910
	325	0.3235	Stücker, 1905
	625	0.4352	"
Manganese.....	−188 to +20	0.093	Richards & Jackson 1910
	−100	0.0979	Laemmel, 1905
	0	0.1072	"
	100	0.1143	"
	325	.....	Stücker, 1905
Mercury:			
solid.....	−213	0.0266	Pollitzer, 1911
"	−183	0.0285	"
"	−185 to +20	0.032	Nordmeyer-Bernouli, 1907
"	−78 to −40	0.0315	Regnault, 1849
liquid.....	0	0.03346	Barnes & Cooke, 1903
"	20	0.03326	" "
"	40	0.03309	" "
"	60	0.03295	" "
"	100	0.0328	Naccari, 1888
"	200	0.0323	"
"	250	0.0321	"
Molybdenum...	−185 to +20	0.062	Nordmeyer-Bernouli, 1907

SPECIFIC HEAT OF ELEMENTS (Continued)

Element.	Temp. °C.	Specific heat, Cal./gm.	Observer.
Molybdenum:			
	15–93	0.072	Guichard & Defacqz, 1901
	60	0.0647	Stücker, 1905
	475	0.0750	"
Nickel	−185 to +20	0.092	Nordmeyer-Bernouli, 1907
	−186 to −79	0.0743	Behn, 1900
	−79 to +18	0.0983	"
	15–100	0.1089	Tilden, 1900
	100	0.1128	Pionchon, 1886
	0–200	0.1140	Weiss & Beck, 1908
	0–400	0.1256	" "
	0–800	0.131	" "
Nitrogen, liquid	−208 to −196	0.0284	Alt, 1904
Osmium	19–98	0.311	Regnault
Oxygen, liquid	−200 to −183	0.35	Andrews
Palladium	−186 to +18	0.0528	Behn, 1900
	−79 to +18	0.0567	"
	0–100	0.0592	Violle, 1878
	0–500	0.0632	"
	0–900	0.0672	"
Phosphorus, yellow	−188 to +20	0.169	Richards & Jackson, 1910
	−186 to +20	0.17-	Nordmeyer-Bernouli, 1907
	7–30	0.190	Regnault
red	0–51	0.1829	Wiegand, 1906
Platinum	−180 to +18	0.0293	Behn, 1900
	15–100	0.03224	Bartoli & Stracciati, 1895
	0–500	0.0347	Violle, 1878
	100	0.0275	Tilden, 1903
	500	0.0356	White
	600	0.0344	"
	800	0.0369	"
	1000	0.0382	"
	1200	0.0398	"
	1500	0.0368	"
Potassium	−185 to +20	0.170	Nordmeyer-Bernouli, 1907
	0–22	0.188	Bernini, 1906
	22–56	0.192	"
liquid	78–100	0.217	"
	100–157	0.224	"

SPECIFIC HEAT OF ELEMENTS (Continued)

Element.	Temp. °C.	Specific heat, Cal./gm.	Observer.
Rhodium	10–97	0.0580	Regnault, 1861
Ruthenium	0–100	0.061	Bunsen, 1870
Selenium	−188 to +18	0.068	.....
crystal	22–63	0.084	Bettendorf&Wüllner
Silicon	−185 to +20	0.123	Nordmeyer-Bernouli, 1907
amorphous	−190 to −80	0.091	Russell, 1912
	−79 to +17	0.147	Schimpff, 1910
	3–50	0.179	Russell, 1912
crystal	−40	0.136	Weber, 1875
	21	0.170	"
	129	0.196	"
Silver	−186 to −70	0.0496	Behn, 1900
	−79 to +18	0.0544	"
	−233	0.0175	Nernst, 1911
	−193	0.040	"
	15–100	0.05625	Bartoli & Stracciati, 1895
	500	0.0581	Tilden, 1900
	800	0.076	Pionchon, 1886
fluid	907–1100	0.0748	"
Sodium	−185 to +20	0.253	Nordmeyer-Bernouli, 1907
	−80	0.266	Thum, 1906
	−40	0.279	"
	0	0.293	"
	100	0.323	"
Sulphur	−188 to +18	0.137	.....
rhombic	0–54	0.1728	Wiegand, 1906
monocl.	0–52	0.1809	"
liquid	119–147	0.235	Naccari, 1887
Tantalum	−185 to +20	0.033	Nordmeyer-Bernouli, 1907
	58	0.036	v. Bolton, 1905
	1400	0.043	.....
Tellurium	−188 to +18	0.047	.....
crystal	15–100	0.0483	Kopp, 1865
	15–300	0.0490	Tilden, 1904
Thallium	−185 to +20	0.038	Nordmeyer-Bernouli, 1907
	20–100	0.0326	Schmitz, 1903
Thorium	0–100	0.0276	Nilson, 1883
Tin	−186 to −79	0.0486	Behn, 1900
	−79 to +18	0.0518	"
	20	0.0541	Gaede, 1902

SPECIFIC HEAT OF ELEMENTS (Continued)

Element.	Temp. °C.	Specific heat, Cal./gm.	Observer.
Tin			
	100	0.0565	Gaede, 1902
liquid	250–350	0.0608	Pionchon, 1887
"	1100	0.0758	"
gray	0–18	0.0589	Wigand, 1907
Titanium	−185 to +20	0.082	Nordmeyer-Bernouli, 1907
	20	0.142	Weiss, 1910
Tungsten	−185 to +20	0.036	Nordmeyer-Bernouli, 1907
	15–93	0.034	Guichard & Defacqz, 1901
	20–100	0.034	Gin, 1908
Uranium	0–98	0.028	Blümcke, 1885
	11–98	0.062	Regnault, 1840
Vanadium	0–100	0.1153	Mache, 1897
Zinc	−192 to +20	0.0836	Schmitz, 1903
	−186 to −79	0.080	Behn, 1900
	−79 to +18	0.0895	"
	−233	0.0268	Nernst, 1911
	−193	0.063	"
	20	0.0924	Gaede, 1900
	100	0.0951	"
	300	0.1040	Naccari, 1887
Zirconium	0–100	0.0660	Mixter-Dana, 1873
	0–100	0.068	Wedekind & Lewis, 1910

COLOR SCALE OF TEMPERATURE

This table is the result of an effort to interpret in terms of thermometric readings, the common expressions used in describing temperatures. It is obvious that the values are only approximations.

Color.	Temperature, °C.
Incipient red heat	500–550
Dark red heat	650–750
Bright red heat	850–950
Yellowish red heat	1050–1150
Incipient white heat	1250–1350
White heat	1450–1550

SPECIFIC HEAT OF ALLOYS AND VARIOUS SOLIDS

Values given in calories per gram.

Substance.	Temp. ° C.	Sp. heat.	Observer.
Alloys			
aluminum bronze, 88.7 Cu, 11.3 Al	20–100	0.104	Louguinine
antimony bismuth tin, 21.6Sb, 36.7Bi, 41.7Sn	22–99	.046	Regnault
antimony lead, 37.1Sb, 62.9Pb	10–98	.0388	"
bell metal, 80Cu, 20Sn	14–98	.0862	"
Bismuth tin, 63.8Bi, 36.2Sn	20–99	.0400	"
46.9Bi, 53.1Sn	20–99	.0450	"
56.9Bi, 43.1Sn	17–99	.0450	Person
brass, 60Cu, 40Zn	−186–−79	.0743	Behn
	−79–+18	.0873	"
	20–100	.0917	Voigt
72Cu, 28Zn	14–98	.094	Regnault
bronze, 80Cu, 20Sn	15–98	.086	"
88Cu, 12Sn, 0.94P	20–100	.0874	Voigt
constantan	0	.098	Jaeger, Diesselhorst
	100	.102	" "
German silver	0	.094	Tomlinson
	100	.095	"
invar, 64Fe, 36Ni	−182–+15	.095	"
	15–100	.120	"
	15–600	.126	"
lead bismuth, 39.9Pb, 60.1Bi	16–99	.0317	Person
lead bismuth tin, 32.5Pb, 49.0Bi, 18.5Sn	14–80	.0600n	Person
31.8Pb, 32.0Bi, 36.2Sn	11–98	.0448	Regnault
lead tin, 63.7Pb, 36.3Sn	12–99	.0407	"
46.7Pb, 53.3Sn	10–99	.0451	"
Lipowitz alloy, 24.97Pb, 10.13Cd, 50.66Bi, 14.24Sn	5–50	.0345	Mazotto
manganin	0	.097	Jaeger, Diesselhorst
	100	.095	" "
platinum iridium, 90Pt, 10Ir	20–100	.0323	Pionchon
Rose alloy, 27.5Pb, 48.9Bi, 23.6 Sn	20–89	.0552	Schüz
solder, *see* lead tin			
steel, ordinary (.004C)	20	0.107	Regnault
	100	.117	"
Wood's alloy, 25.85Pb, 6.99Cd, 52.43Bi, 14.73Sn	5–50	.0352	Mazotto
Amalgams			
50.8Pb, 49.2Hg	23–99	.0383	Regnault
78.3Pb, 37.1Sn, 62.9Hg	22–99	.0729	"
54.1Sn, 45.9Hg	25–99	.0659	Schüz
Asbestos	20–98	.195	Ulrich
Basalt	20–100	.20	Mean
Calcspar	0–100	.2005	Lindner
Carborundum	3–44	.162	
Cellulose, dry	.....	.37	Mean
Cement, powder	200–10	.20	
Chalk	20–99	.214	Regnault
Charcoal	10	.16	Weber, 1875
Clay, dry	20–100	.22	Mean
Ebonite	20–100	.40	Louguinine, 1882
Glass, normal thermometer	19–100	.1988	Wachsmuth
crown	10–50	.161	KH. Meyer
flint	10–50	.117	H. Meyer

SPECIFIC HEAT OF ALLOYS AND VARIOUS SOLIDS (Continued)

Values given in calories per gram

Substance.	Temp. ° C.	Sp. heat.	Observer.
Granite	12–100	.192	Joly
Ice	−200	.168	Nernst, 1910
	−180	.199	" "
	−160	.230	" "
	−140	.262	" "
	−100	.325	" "
	− 60	.392	" "
	− 20	.480	" "
	− 10	.530	" "
India rubber (Para)	?–100	.481	Gee and Terry
Leather, dry	.....	.36	
Marble	0–100	.21	
Mica (Mg)	20–98	.2061	Ulrich
Paraffin	0–20	.6939	R. W. Weber
Porcelain	15–950	.26	Harker, 1905
Quartz	12–100	.188	Joly
Rock-salt	13–45	.219	Kopp
Sugar	20	.274	Hess, 1888
Vulcanite	20–100	.3312	A. M. Mayer
Wood	.....	.42	

SPECIFIC HEAT

Variation with Temperature

The table gives the true specific heat at the temperatures named. From data of Wüst, Meuthen, and Durrer, 1918.

°C	Pb	Zn	Al	Ag	Au	Cu	Ni	Fe	Co	Quartz
0°C	0.0359	0.0878	0.2220	0.0573	0.0317	0.1008	0.1095	0.1055	0.0912	.....
100	0.0336	0.0965	0.2297	0.0583	0.0320	0.1014	0.1200	0.1168	0.0993	0.2372
200	0.0313	0.1052	0.2374	0.0594	0.0322	0.1020	0.1305	0.1282	0.1073	0.2416
300	0.0290	0.1139	0.2451	0.0605	0.0325	0.1026	0.1409	0.1396	0.1154	0.2460
400	0.0266	0.1226	0.2529	0.0616	0.0328	0.1032	0.1294	0.1509	0.1235	0.2504
500	0.0259	0.1173	0.2606	0.0627	0.0330	0.1038	0.1294	0.1623	0.1316	0.2548
600	0.0252	0.1141	0.2683	0.0638	0.0333	0.1045	0.1294	0.1737	0.1396	0.2592
700	0.0246	0.1109	0.2523	0.0649	0.0335	0.1051	0.1295	0.1850	0.1477	0.2636
800	0.0239	0.1076	0.2571	0.0660	0.0338	0.1057	0.1295	0.1592	0.1558	0.2680
900	0.0233	0.1044	0.2619	0.0671	0.0341	0.1063	0.1295	0.1592	0.1639	0.2724
1000	0.0226	0.1012	0.2667	0.0637	0.0343	0.1069	0.1295	0.1448	.....	0.2768
1100	.....	.....	.....	0.0694	0.0329	0.1028	0.1296	0.1448	0.1424	0.2812
1200	.....	.....	.....	0.0750	0.0346	0.1159	0.1296	0.1448	0.1454	0.2856
1300	.....	.....	.....	0.0807	0.0364	0.1291	0.1296	0.1449	0.1483	0.2900
1400	.....	.....	.....	.....	.....	.....	0.1296	0.1449	0.1512	0.2944
1500	.....	.....	.....	.....	.....	.....	0.1338	0.2142	0.1472	0.2988
1600	.....	.....	.....	.....	.....	.....	.....	0.1501	0.1472	.....

SPECIFIC HEAT OF VARIOUS LIQUIDS

Liquid.	Temp. ° C.	Sp. heat.	Observer.
Acetic acid	20	0.472	Schiff, 1886
Acetone	0	.506	Regnault, 1862
Alcohol, ethyl	0	.548	Regnault
ethyl	40	.648	Regnault
methyl	5–10	.590	Regnault
methyl	15–20	.601	Regnault
Amyl acetate	20	.459	Schiff, 1880
Benzol, C_6H_6	10	.340	de Heen & Deruyts
Benzol	40	.423	de Heen & Deruyts
Carbon bisulphide	30	.240	Regnault
Chloroform	0	.232	Regnault
Ethyl ether	0	.529	Regnault
Glycerine	15–50	.576	Emo
Oils, olive	6.6	.471	
turpentine	0	.411	Regnault
Petroleum	21–58	.511	Pagliani

SPECIFIC HEAT FOR AQUEOUS SOLUTIONS

Giving the specific heat referred to that of water at the same temperatures. Concentration of the solutions is stated as the number of molecules of water to each molecule of the solutes (anhydrous.)

Values from Marignac, Thomsen and others.

Substance	Temp. °C.	Concentration		
		25	50	100
Acetic acid	21–52	0.957	0.977	0.987
Aluminum sulphate	21–53	.....	.....	0.870
Ammonium acetate	17.5	0.911	0.951	0.976
chloride	18	0.881	0.937	0.966
hydroxide	18	.....	0.999	.....
nitrate	18	0.880	0.929	0.962
sulphate	19–51	0.803	0.879	0.933
Barium chloride	22–27	.....	0.780	0.875
Cadmium sulphate	12	0.696	0.813	0.893
Calcium acetate	22–52	.....	0.896	0.939
chloride	21–51	0.754	0.851	0.917
nitrate	21–51	0.760	0.846	0.911
Chromic acid	21–53	0.825	0.896	0.942
Copper chloride	19–51	0.779	0.864	0.920
nitrate	18–50	.....	0.826	0.899
sulphate	18–23	.....	0.841	0.908
Ferric chloride	0–98	0.666	0.750	0.854

SPECIFIC HEAT OF AQUEOUS SOLUTIONS
(Continued)

Giving the specific heat referred to that of water at the same temperatures. Concentration of the solutions is stated as the number of molecules of water to each molecule of the solutes (anhydrous).

Values from Marignac, Thomsen and others.

Substance.	Temp. °C.	Concentration.		
		25	50	100
Hydrochloric acid	18	.....	0.932	0.964
Lactic acid	16.5	0.947	0.970	0.982
Lead acetate	18–51	0.682	0.794	0.881
nitrate	18–51	.....	0.750	0.851
Lithium chloride	11	.....	0.941	0.973
hydroxide	13	.....	0.958	0.978
Magnesium chloride	22–52	0.772	0.866	0.923
nitrate	19–51	.....	0.832	0.903
Sulphate	18	.....	0.857	0.917
Manganese chloride	0–98	0.787	0.861	0.914
nitrate	19–51	.....	0.832	0.903
sulphate	19–51	.....	0.844	0.912
Nickel chloride	24–55	0.735	0.831	0.902
nitrate	24–55	0.717	0.823	0.895
sulphate	25–56	.....	0.837	0.910
Nitric acid	18	.....	0.930	0.963
Oxalic acid	20–52	.....	0.942	0.965
Potassium bromide	20–51	0.769	0.864	0.925
carbonate	21–52	0.760	0.851	0.916
chloride	18	0.828	0.904	0.948
chromate	20–51	.....	0.810	0.890
hydroxide	18	.....	0.916	0.954
iodide	20–51	0.715	0.830	0.906
nitrate	18–23	0.832	0.900	0.943
oxalate	21–52	.....	0.839	0.908
sulphate	19–52	.....	.....	0.902
Silver nitrate	25–52	0.750	0.849	0.913
Sodium acetate	18	.....	0.938	0.965
bromide	20–52	0.809	0.886	0.939
carbonate	21–52	0.865	0.907	0.943
chloride	18	0.880	0.931	0.962
chromate	21–52	0.781	0.856	0.913
hydroxide	18	0.908	0.942	0.968
iodide	20–51	0.749	0.850	0.917
nitrate	18	0.863	0.918	0.950
sulphate	21–52	0.819	0.878	0.960
Strontium chloride	21–26	.....	0.814	0.894
nitrate	19–51	.....	0.817	0.890
Sulphuric acid	21	0.854	0.915	0.956
Zinc chloride	19–51	0.796	0.884	0.933
nitrate	20–52	0.718	0.823	0.899
sulphate	20–52	.....	0.842	0.911

SPECIFIC HEAT OF GASES

Giving the specific heat of gases at constant pressure in calories per gram and the ratio of the specific heat at constant pressure to that at constant volume.

Values are for atmospheric pressure.
(Selected from Smithsonian Tables.)

Gas or vapor.	Specific heat at constant pressure.			Ratio of specific heats.		
	Temp. °C.	Sp. ht.	Obs.*	Temp. °C.	Ratio Cp/Cv	Obs.*
Acetone	26–110	0.3468	W			
Air	0–100	0.2374	R			
Air	0–200	0.2375	R			
Air	20–630	0.2429	A			
Alcohol	108–220	0.4534	R	53	1.133	J
Ammonia	23–100	0.5202	W	0	1.3172	Wr
Argon	20–90	0.1233	D	0	1.667	N
Benzol	34–115	0.2990	W	20	1.403	P
Bromine	83–228	0.0555	R	20–388	1.293	S
Carbon dioxide	15–100	0.2025	R			
Carbon monoxide	23–99	0.2425	W	0	1.403	Wr
Carbon disluphide	86–190	0.1596	R	3.67	1.205	B
Chlorine	13–202	0.1241	R	20–340	1.323	S
Chloroform	27–118	0.1441	W	22–78	1.102	B
Ether	25–111	0.4280	W	12–20	1.024	L
Hydrochloric acid	13–100	0.1940	S	20	1.389	S
Hydrogen	12–198	3.4090	R			
Hydrogen sulphide	20–206	0.2451	R	10–40	1.276	Mr
Methane	18–208	0.5929	R	11–30	1.316	Mr
Nitrogen	0–200	0.2438	R	....	1.41	C
Nitric oxide	13–172	0.2317	R			
Nitrous oxide	16–207	0.2262	R	0	1.311	Wr
Oxygen	13–207	0.2175	R	5–14	1.3977	L–P
Sulphur dioxide	16–202	0.1544	R	16–34	1.256	Mr
Water vapor	0	0.4655	T	78	1.274	B
Water vapor	100	0.421	T	94	1.33	J
Water vapor	180	0.51	T			

*A Austin
B Beyme
C Cazin
D Dittenberger
J Jaeger
L Low
L–P Lummer & Pringsheim
Mr Muller
N Niemeyer
P Pagliani
R Regnault
S Strecker
T Thiesen
W Wiedemann
Wr Wüllner

BOILING–POINT OF WATER*

(Hydrogen Scale)

Pressure mm.	Tenths of millimeters									
	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9
700	97.714	718	722	725	729	733	737	741	745	749
701	753	757	761	765	769	773	777	781	785	789
702	792	796	800	804	808	812	816	820	824	828
703	832	836	840	844	847	851	855	859	863	867
704	871	875	879	883	887	891	895	899	902	906
705	97.910	914	918	922	926	930	934	938	942	946
706	949	953	957	961	965	969	973	977	981	985
707	989	993	996	*000	*004	*008	*012	*016	*020	*024
708	98.028	032	036	040	043	047	051	055	059	063
709	067	071	075	079	082	086	090	094	098	102
710	98.106	110	114	118	121	125	129	133	137	141
711	145	149	153	157	160	164	168	172	176	180
712	184	188	192	195	199	203	207	211	215	219
713	223	227	230	234	238	242	246	250	254	258
714	261	265	269	273	277	281	285	289	292	296
715	98.300	304	308	312	316	320	323	327	331	335
716	339	343	347	351	355	358	362	366	370	374
717	378	382	385	389	393	397	401	405	409	412
718	416	420	424	428	432	436	440	443	447	451
719	455	459	463	467	470	474	478	482	486	490
720	98.493	497	501	505	509	513	517	520	524	528
721	532	536	540	544	547	551	555	559	563	567
722	570	574	578	582	586	590	593	597	601	605
723	609	613	617	620	624	628	632	636	640	643
724	647	651	655	659	662	666	670	674	678	682
725	98.686	689	693	697	701	705	709	712	716	720
726	724	728	732	735	739	743	747	751	755	758
727	762	766	770	774	777	781	785	789	793	797
728	800	804	808	812	816	819	823	827	831	835
729	838	842	846	850	854	858	861	865	869	873
730	98.877	880	884	888	892	896	899	903	907	911
731	915	918	922	926	930	934	937	941	945	949
732	953	956	960	964	968	972	975	979	983	987
733	991	994	998	*002	*006	*010	*013	*017	*021	*025
734	99.029	032	036	040	044	048	051	055	059	063
735	99.067	070	074	078	082	085	089	093	097	101
736	104	108	112	116	119	123	127	131	135	138
737	142	146	150	153	157	161	165	169	172	176
738	180	184	187	191	195	199	203	206	210	214
739	218	221	225	229	233	236	240	244	248	252
740	99.255	259	263	267	270	274	278	282	285	289
741	293	297	300	304	308	312	316	319	323	327
742	331	334	338	342	346	349	353	357	361	364
743	368	372	376	379	383	387	391	394	398	402
744	406	409	413	417	421	424	428	432	436	439
745	99.443	447	451	454	458	462	466	469	473	477
746	481	484	488	492	495	499	503	507	510	514
747	518	522	525	529	533	537	540	544	548	552
748	555	559	563	566	570	574	578	581	585	589
749	592	596	600	604	607	611	615	619	622	626

* See also under Vapor Tension.

BOILING-POINT OF WATER (Continued)

(Hydrogen Scale)

Pressure mm.	Tenths of millimeters									
	.0	.1	.2	.3	4	.5	.6	.7	.8	.9
750	99.630	633	637	641	645	648	652	656	659	663
751	667	671	674	678	682	686	689	693	697	700
752	704	708	712	715	719	723	726	730	734	738
753	741	745	749	752	756	760	764	767	771	775
754	778	782	786	790	793	797	801	804	808	812
755	99.815	819	823	827	830	834	838	841	845	849
756	852	856	860	863	867	871	875	878	882	886
757	889	893	897	900	904	908	911	915	919	922
758	926	930	934	937	941	945	948	952	956	959
759	963	967	970	974	978	982	985	989	993	996
760	100.000	004	007	011	015	018	022	026	029	033
761	037	040	044	048	052	055	059	063	066	070
762	074	077	081	085	088	092	096	099	103	107
763	110	114	118	121	125	129	132	136	140	143
764	147	151	154	158	162	165	169	173	176	180
765	100.184	187	191	195	198	202	206	209	213	216
766	220	224	227	231	235	238	242	246	249	253
767	257	260	264	268	271	275	279	283	286	290
768	293	297	300	304	308	311	315	319	322	326
769	330	333	337	341	344	348	352	355	359	363
770	100.366	370	373	377	381	384	388	392	395	399
771	403	406	410	414	417	421	424	428	432	435
772	439	442	446	450	453	457	461	464	468	472
773	475	479	483	486	490	493	497	501	504	508
774	511	515	519	522	526	530	533	537	540	544
775	100.548	551	555	559	562	566	569	573	577	580
776	584	588	591	595	598	602	606	609	613	616
777	620	624	627	631	634	638	642	645	649	653
778	656	660	663	667	671	674	678	681	685	689
779	692	696	689	703	707	710	714	718	721	725
780	100.728	732	735	739	743	746	750	753	757	761
781	764	768	772	775	779	782	786	789	793	797
782	800	804	807	811	815	818	822	825	829	833
783	836	840	843	847	851	854	858	861	865	869
784	872	876	879	883	886	890	894	897	901	904
785	100.908	912	915	919	922	926	929	933	937	940
786	944	947	951	954	958	962	965	969	972	976
787	979	983	987	990	994	997	*001	*005	*008	*012
788	101.015	019	022	026	029	033	037	040	044	047
789	051	054	058	062	065	069	072	076	079	083
790	101.087	090	094	097	101	104	108	112	115	119
791	122	126	129	133	136	140	144	147	151	154
792	158	161	165	168	172	176	179	183	186	190
793	193	197	200	204	207	211	215	218	222	225
794	229	232	236	239	243	246	250	254	257	261
795	101.264	268	271	275	278	282	286	289	293	296
796	300	303	307	310	314	317	321	324	328	332
797	335	339	342	346	349	353	356	360	363	367
798	370	374	377	381	385	388	392	395	399	402
799	406	409	413	416	420	423	427	430	434	437
800	101.441	...	...	...	.....	...	...	...	...	...

MELTING AND BOILING POINTS OF THE ELEMENTS

The following table gives the melting and boiling temperatures of the Elements. Boiling points are at atmospheric pressure.

Element	Melting Point, °C.	Observer	Boiling Point, °C.	Observer
Aluminum	658.7	Burgess	1800	Greenwood, 1909
Antimony	630.0	.....	1440	"
Argon	−188	Ramsay-Travers	−186.1	Ramsay-Travers
Arsenic	850	Sublimes	.....	.....
	500	Gluntz, Broniewski, 1907	Black 360	Conechy
Barium	850	Gluntz	.....	.....
Beryllium	1280	.....	.....	.....
Bismuth	271	Adjusted	1430	Barus, 1894
Boron	2200–2500?	.....	.....	.....
	2400	Gertler, Pirani	.....	.....
Bromine	−7.3	.....	61.1	Thorpe, 1880
Cadmium	320.9	.....	778	Berthelot, 1902
Caesium	26	.....	670	Ruff-Johannsen.
Calcium	810	Adjusted	.....	.....
Carbon	(>3500)	Sublimes	3600	Violle, 1895
	3600	Gertler, Pirani, 1919	.....	.....
Cerium	640	.....	.....	.....
	700	Pirani, 1919	.....	.....
Chlorine	−101.5	Olszewski	−33.6	Regnault, 1863
Chromium	1615	Burgess-Waltenberg	2200	Greenwood, 1909
	1520	Gertler, Pirani	.....	.....
Cobalt	1480	Burgess-Waltenberg	.....	.....
Copper	1083 ± 3	Mean, Holborn Day, Day-Clement	2310	Greenwood
Erbium	.....	.....	.....	.....
Fluorine	−223	Moissan-Dewar	−187	Moisson-Dewar, 1903
Gallium	30.1	.....	.....	.....
Germanium	958	.....	.....	.....
Glucinum	1300	Guertler, Pirani	.....	.....
Gold	1063.0	Adjusted	.....	.....
Helium	< −271	.....	−267	Computed

MELTING AND BOILING POINTS OF THE ELEMENTS (Continued)

Element	Melting Point, °C.	Observer	Boiling Point, °C.	Observer
Hydrogen	−259	.....	−252.6	Mean
Indium	155	Thiel	.....	.....
Iodine	113.5	.....	>200	.....
Iridium	2350?	.....	.....	.....
Iron	1530	Burgess-Waltenberg	2450	Greenwood
Krypton	−169	Ramsay	−151.7	Ramsay
Lanthanum	810?	Muthmann-Weiss	.....	.....
Lead	327 ± 0.5	.....	1525	Greenwood
Lithium	186	Kahlbaum	1400	Ruff-Johannsen, 1905
Magnesium	651	Grube	1120	Greenwood
Manganese	1230	Burgess-Waltenberg	1900	"
	1210	Guertler, Pirani	.....	.....
Mercury	−38.87	.....	357	Crafts, Regnault
	−39.7	Guertler, Pirani	.....	.....
Molybdenum	2535	Mendenhall-Forsythe	3620	Langmuir, Mackay
	2410	Guertler, Pirani	.....	.....
Neodymium	840?	Muthmann-Weiss	.....	.....
Neon	−253?	.....	−239	Dewar, 1901
Nickel	1452	Day, Sosman, Burgess, Waltenberg	.....	.....
Niobium	1700?	.....	.....	.....
Nitrogen	−211	Fisher-Alt	−195	Mean
Osmium	About 2700	Waidner, Burgess	.....	.....
Oxygen	−218	.....	−182.7	Mean
Ozone	−250	Reisenfeld, Schwab, 1922	−119	Troost
Palladium	1549 ± 5	Waidner-Burgess, Nernst-Wartenburg, Day & Sosman.	.....	.....
Phosphorous	44.2	.....	288	.....
Platinum	1755 ± 5	.....	3910	Langmuir, Mackay
Potassium	62.3	.....	760	
Praesodymium	940	Muthmann-Weiss	.....	.....
Radium	700	.....	.....	.....
Rhodium	1950	Mendenhall-Ingersoll	.....	.....

MELTING AND BOILING POINTS OF THE ELEMENTS (Concluded)

Element	Melting Point, °C.	Observer	Boiling Point, °C.	Observer
Rubidium	38	.....	696	Ruff-Johannsen
Ruthenium	2450?	.....	.....	.....
Samarium	1300–1400	Muthmann-Weiss	.....	.....
Scandium	?	.....	690	.....
Selenium	217–220	.....	.....	.....
Silicon	1420	Adjusted	1955	Greenwood, Perman
Silver	960.5	"	880	
Sodium	97.5	.....	.....	.....
Strontium	900 (?)	.....		
Sulphur	Si 112.8 Sii 119.2 Siii 106.8	Various forms	444.7	Mean
			.....	.....
Tantalum	2900	Adjusted	1390	Deville-Troost
Tellurium	452	Adjusted	1280	v. Wartenburg
Thallium	302	.....	.....	.....
Thorium	1842 ± 30	Rentschler, Marden, 1925		
Tin	231.9 ± 2	.....	2270	Greenwood
Titanium	1795	Burgess-Waltenberg	.....	.....
	2000	Guertler, Pirani	.....	.....
Tungsten	3400	Adjusted	5830	Langmuir, 1913
	3395	Worthing, 1917	.....	.....
Uranium	<1850	Moissan	.....	.....
Vanadium	1720	Burgess-Waltenberg, Guertler, Pirani	.....	.....
	1800		.....	.....
Xenon	−140	Ramsay	−109.1	Ramsay, 1903
Ytterbium			.....	.....
Yttrium	1490	.....	930	.....
Zinc	419.4	.....	.....	.....
Zirconium	1700?	Troost		

MELTING POINTS OF MIXTURES OF METALS

(*Smithsonian Physical Tables*)

Melting-points, °C.

Metals	Percentage of metal in second column.										
	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
Pb. Sn.	326	295	276	262	240	220	190	185	200	216	232
Bi.	322	290	...	...	179	145	126	168	205	....	268
Te.	322	710	790	880	917	760	600	480	410	425	446
Ag.	328	460	545	590	620	650	705	775	840	905	959
Na.	...	360	420	400	370	330	290	250	200	130	96
Cu.	326	870	920	925	945	950	955	985	1005	1020	1084
Sb.	326	250	275	330	395	440	490	525	560	600	632
Al. Sb.	650	750	840	925	945	950	970	1000	1040	1010	632
Cu.	650	630	600	560	540	580	610	755	930	1055	1084
Au.	655	675	740	800	855	915	970	1025	1055	675	1062
Ag.	650	625	615	600	590	580	575	570	650	750	954
Zn.	654	640	620	600	580	560	530	510	475	425	419
Fe.	653	860	1015	1110	1145	1145	1220	1315	1425	1500	1515
Sn.	650	645	635	625	620	605	590	570	560	540	232
Sb. Bi.	632	610	590	575	555	540	520	470	405	330	268
Ag.	630	595	570	545	520	500	505	545	680	850	959
Sn.	622	600	570	525	480	430	395	350	310	255	232
Zn.	632	555	510	540	570	565	540	525	510	470	419
Ni. Sn.	1455	1380	1290	1200	1235	1290	1305	1230	1060	800	232
Na. Bi.	96	425	520	590	645	690	720	730	715	570	268
Cd.	96	125	185	245	285	325	330	340	360	390	322
Cd. Ag.	322	420	520	610	700	760	805	850	895	940	954
Tl.	321	300	285	270	262	258	245	230	210	235	302
Zn.	322	280	270	295	313	327	340	355	370	390	419
Au. Cu.	1063	910	890	895	905	925	975	1000	1025	1060	1084
Ag.	1064	1062	1061	1058	1054	1049	1039	1025	1006	982	963
Pt.	1075	1125	1190	1250	1320	1380	1455	1530	1610	1685	1775
K. Na.	62	17.5	−10	−3.5	5	11	26	41	58	77	97.5
Hg.	...	...	...	...	...	90	110	135	162	265	...
Tl.	62.5	133	165	188	205	215	220	240	280	305	301
Cu. Ni.	1080	1180	1240	1290	1320	1355	1380	1410	1430	1440	1455
Ag.	1082	1035	990	945	910	870	830	788	814	875	960
Sn.	1084	1005	890	755	725	680	630	580	530	440	232
Zn.	1084	1040	995	930	900	880	820	780	700	580	419
Ag. Zn.	959	850	755	705	690	660	630	610	570	505	419
Sn.	959	870	750	630	550	495	450	420	375	300	232
Na. Hg.	96.5	90	80	70	60	45	22	55	95	215	...

• The data in this table are compiled from various sources,— hence the variations in the melting point of the metals as shown in this column.

MELTING AND BOILING TEMPERATURES

Temperature of Fusion for Various Substances for Atmospheric Pressure

For the melting- and boiling-points of the chemical elements and of inorganic compounds see under Physical Constants of the Elements, and Physical Constants of Inorganic Compounds.

Substance.	Temp. of fusion ° C.	Substance.	Temp. of fusion ° C.
Acetylene	−81	German silver	1000.
Alcohol, ethyl	−130.	Glass	1100.
Brass	900.	Glycerine	17.
Butter	31–31.5	Olive oil	2–6
Camphor	177.7	Paraffin	55.
Caoutchouc, pure gum	120.	Resin	135.
Chloroform	−63.2	Sea water	−2.5
Ether	−117.6	Sugar (cane)	160.

Boiling-point for Various Substances

Giving the boiling-point at atmospheric pressure and the variation per cm. pressure near 76 cm.

Substance.	Temp. ° C.	Variation.
Acetone	57.	0.39
Acetylene	−72.2	
Alcohol, ethyl	78.3	0.34
methyl	64.7	0.35
Amyl acetate	148.	
Benzene	80.	0.43
Camphor	205.	0.56
Chloroform	61.2	0.41
Ether	34.6	0.40
Gasoline	70–90.	
Glycerine	291.	
Turpentine	159.	

MELTING POINT OF ICE—VARIATION WITH PRESSURE

(From Tamann, 1900, by permission.)

Pressure in kg. per sq.cm.	Temp. ° C.	Pressure in kg. per sq.cm.	Temp. ° C.
1	0.0	1410	−12.5
336	− 2.5	1625	−15.0
615	− 5.0	1835	−17.5
890	− 7.5	2042	−20.0
1155	−10.0	2200	−22.1

BOILING POINTS OF WATER-ALCOHOL MIXTURES

(P. N. Evans, Journal of Industrial and Engineering Chemistry.)

Boiling point, °C.	Weight per cent alcohol in		Boiling point, °C.	Weight per cent alcohol in	
	Liquid.	Vapor.		Liquid.	Vapor.
78.2	91	92	86.5	18	71
78.4	85	89	87.0	17	70
78.6	82	88	87.5	16	69
78.8	80	87	88.0	15	68
79.0	78	86	88.5	13	67
79.2	76	85	89.0	12	65
79.4	74	85	89.5	11	63
79.6	72	84	90.0	10	61
79.8	69	84	90.5	10	59
80.0	67	83	91.0	9	57
80.2	64	83	91.5	8	55
80.4	62	82	92.0	8	53
80.6	59	82	92.5	7	51
80.8	56	81	93.0	6	49
81.0	53	81	93.5	6	46
81.2	50	80	94.0	5	44
81.4	47	80	94.5	5	42
81.6	45	80	95.0	4	39
81.8	43	79	95.5	4	36
82.0	41	79	96.0	3	33
82.5	36	78	96.5	3	30
83.0	33	78	97.0	2	27
83.5	30	77	97.5	2	23
84.0	27	76	98.0	1	19
84.5	25	75	98.5	1	15
85.0	23	74	99.0	0	10
85.5	21	73	99.5	0	5
86.0	20	72	100.0	0	0

MOLECULAR ELEVATION OF THE BOILING POINT

Showing the elevation of the boiling point due to the addition of one gram molecular weight of the dissolved substance, for various solvents.

Solvent	Constant for one gram molecular weight dissolved in 100 gms. °C.	Constant for one gram molecular weight dissolved in 100 c.c. at the boiling point. °C.
Acetic acid	25.4–30.7	....
Acetone	16.7	22.2
Aniline	32.2–34.1	....
Benzene	26.7	32.0
Chloroform	36.6	26.0
Ether	21.1	30.3
Ethyl acetate	27.9	....
Ethyl alcohol	11.5	15.6
Methyl acetate	20.6	....
Methyl alcohol	8.4–9.3	....
Nitrobenzene	50.1–50.4	....
Phenol	30.4	....
Water	5.2	5.4

MOLECULAR DEPRESSION OF THE FREEZING POINT

Showing the depression of the freezing point due to the addition of one gram molecular weight of dissolved substance, for various solvents.

Solvent	Depression for one gram molecular weight dissolved in 100 gms. °C.
Acetic acid	39.0
Benzene	49.0
Benzophenone	98.0
Diphenyl	80.0
Diphenylamine	86.0
Ethylene dibromide	118.0
Formic acid	27.7
Naphthalene	68–69
Nitrobenzene	70.0
Phenol	74.0
Stearic acid	45.0
Triphenyl methane	124.5
Urethane	51.4
Water	18.5–18.7

CRITICAL AND VAN DER WAALS' CONSTANTS FOR GASES

Name.	Critical.			Van der Waals'.	
	Temp., ° C.	Pressure, atm.	Density, gms. per cm.³	a	b
Acetylene	36.5	61.6	0.2315	0.00880	0.00230
Air	−140	39	.....	0.00257	0.00156
Ammonia	130	115.0	.....	0.00798	0.00161
Aniline	425.6	52.3	.....	0.05282	0.00611
Argon	−117.4	52.9	.....	0.00259	0.00135
Benzene	288.5	47.9	0.3045	0.03726	0.00537
Bromine	302	131	.....	0.01434	0.00202
Carbon bisulphide	273	72.9	0.4408	0.02316	0.00343
Carbon dioxide	31.1	73	0.464	0.00717	0.00191
Carbon monoxide	−141.1	35.9	0.328	0.00275	0.00168
Chlorine	146	93.5	0.547	0.01063	0.00205
Chloroform	260	54.9	.....	0.0293	0.00445
Ethane	34	50.2	.....	0.01060	0.0028
Ether	197	35.8	0.2622	0.03496	0.00602
Ethyl alcohol	243	62.7	0.2755	0.02407	0.00377
Ethylene	10	51.7	0.210	0.00877	0.00251
Helium	−268	2.3	.....	0.0000615	0.0000995
Hydrochloric acid	52.3	86	.....	0.00697	0.00173
Hydrogen	−234.5	20	0.03346	0.00042	0.00088
Hydrogen sulphide	100	88.7	.....	0.00888	0.00193
Krypton	− 62.5	54.3	.....	0.00462	0.00178
Methane	− 95.5	50	.....	0.00357	0.00162
Neon	−228.7	29	.....	.....	.....
Nitric oxide, NO	− 93.5	71.2	0.524	0.00257	0.00116
Nitrogen	−146	33	0.3269	0.00259	0.00165
Nitrogen tetroxide, NO_2	171.2	147	.....	0.00756	0.00138
Nitrous oxide, N_2O	38.8	77.5	0.454	0.00710	0.00184
Oxygen	−118	50	0.4292	0.00273	0.00142
Sulphur dioxide	155.4	78.9	0.520	0.01316	0.00249
Water	365	194.6	0.329	0.0118	0.00150
Xenon	14.7	57.2	.....	0.00818	0.00230

FREEZING MIXTURES

A is the proportion of the substance named in the first column to be added to the proportion of the substance given in column *B*. The table gives the temperature of the separate ingredients and the temperature attained by the mixture.

(From Smithsonian Tables.)

Substance.	*A*	*B*	Initial Temp. ° C.	Temp. ° C. attained by mixt.
$NaC_2H_3O_2$ (cryst.)	85	H_2O 100	10.7	− 4.7
NH_4Cl	30	H_2O 100	13.3	− 5.1
$NaNO_3$	75	H_2O 100	13.2	− 5.3
$Na_2S_2O_3$ (cryst.)	110	H_2O 100	10.7	− 8.0
KI	140	H_2O 100	10.8	−11.7
$CaCl_2$ (cryst.)	250	H_2O 100	10.8	−12.4
NH_4NO_3	60	H_2O 100	13.6	−13.6
$CaCl_2$	30	* Snow 100	− 1	−10.9
NH_4Cl	25	Snow 100	− 1	−15.4
NH_4NO_3	45	Snow 100	− 1	−16.75
$NaNO_3$	50	Snow 100	− 1	−17.75
NaCl	33	Snow 100	− 1	−21.3
$H_2SO_4+H_2O$ ($66.1\%H_2SO_4$)	1	Snow 1.097	− 1	−37.0
	1	Snow 2.52	− 1	−30.0
	1	Snow 4.32	− 1	−25.0
	1	Snow 7.92	− 1	−20.0
	1	Snow 13.08	− 1	−16.0
$CaCl_2+6H_2O$	1	Snow .49	0	−19.7
	1	Snow .61	0	−39.0
	1	Snow .70	0	−54.9
	1	Snow .81	0	−40.3
	1	Snow 1.23	0	−21.5
	1	Snow 2.46	0	− 9.0
	1	Snow 4.92	0	− 4.0
Alcohol at 4°	77	Snow 73.	0	−30.0
	..	CO_2 solid	.....	−72.0
Chloroform	....	CO_2 solid	.....	−77.0
Ether	....	CO_2 solid	.....	−77.0
Liquid SO_2	....	CO_2 solid	.....	−82.0
NH_4NO_3	1	H_2O .94	20	− 4.0
	1	Snow .94	0	− 4.0
	1	H_2O 1.20	10	−14.0
	1	Snow 1.20	0	−14.0
	1	H_2O 1.31	10	−17.5
	1	Snow 1.31	0	−17.5

* Or finely pulverized ice.

PERCENTAGE COMPOSITION OF ANTI-FREEZE SOLUTIONS

Alcohol and Water Solutions

% alcohol by weight	Sp. gr. 20°/4° C. (68° F.)	Point of crystallization	
		Deg. C.	Deg. F.
2.5	0.99363	−1.0	30.2
4.8	0.98971	−2.0	28.4
6.8	0.98658	−3.0	26.6
11.3	0.98006	−5.0	23.0
13.8	0.97670	−6.1	21.0
16.4	0.97336	−7.5	18.5
17.5	0.97194	−8.7	16.3
18.8	0.97024	−9.4	15.1
20.3	0.96823	−10.6	12.9
22.1	0.96578	−12.2	10.0
24.2	0.96283	−14.0	6.8
26.7	0.95914	−16.0	3.2
29.9	0.95400	−18.9	−2.0
33.8	0.94715	−23.6	−10.5
39.0	0.93720	−28.7	−19.7
46.3	0.92193	−33.9	−29.0
56.1	0.90008	−41.0	−41.8
71.9	0.86311	−51.3	−60.3

Glycerol (Glycerine) and Water Solutions*

% glycerol by weight	Sp. gr. 15°/15° C. (59° F.)	Sp. gr. 20°/20° C. (68° F.)	Freezing point	
			Deg. C.	Deg. F.
10	1.26557	1.26362	−1.6	29.1
20	1.23950	1.23755	−4.8	23.4
30	1.21290	1.21090	−9.5	14.9
40	1.18540	1.18355	−15.4	4.3
50	1.15770	1.15605	−23.0	−9.4
60	1.12985	1.12845	−34.7	−30.5
70	1.10255	1.10135	−38.9	−38.0
80	1.07560	1.07470	−20.3	−5.5
90	1.04935	1.04880	−1.6	29.1
100	1.02415	1.02395	17.0	62.6

* Bosart and Snoddy, Jour. Ind. Eng. Chem. 19, 506 (1927); Lane, ibid. 17, 924 (1925). The Chemical Division of the Proctor and Gamble Co. suggest that a correction of +2° F. be added to all temperatures below zero degree Fahrenheit.

Ethylene Glycol (Prestone) and Water Solutions

% glycol by volume	Sp. gr. 15.6° C. (60° F.)	Freezing point	
		Deg. C.	Deg. F.
12.5	1.019	−3.9	25
17.0	1.026	−6.7	20
25.0	1.038	−12.2	10
32.5	1.048	−17.8	0
38.5	1.056	−23.3	−10
44.0	1.063	−28.9	−20
49.0	1.069	−34.4	−30
52.5	1.073	−40.0	−40

HEAT EQUIVALENT OF FUSION

The table gives the heat equivalent in calories per gram at the temperature of fusion.

(From Smithsonian Tables.)

Substance.	Temp. ° C.	Heat cal/g.	Observer.
Aluminum	658.	76.8	Glaser
Ammonia	−75.	108.	Massol
Benzole	5.4	30.6	Mean
Bromine	−7.3	16.2	Regnault
Bismuth	268.	12.64	Person
Cadmium	320.7	13.66	Person
Calcium chloride	28.5	40.7	Person
Copper	1083	42.	Mean
Iron, gray cast	.....	23.	Grumer
white cast	.....	33.	Grumer
slag	.....	50.	Grumer
Iodine	.....	11.71	Favre & Silbermann
Ice	0	79.24	Regnault
Ice	0	80.02	Bunsen
Ice from sea water	−8.7	54.0	Petterson
Lead	327	5.86	Rudberg
Mercury	−39	2.82	Person
Naphthalene	79.87	35.62	Pickering
Nickel	1435	4.64	Pionchon
Palladium	1545	36.3	Violle
Phosphorus	44.2	4.97	Petterson
Platinum	1755	27.2	Violle
Potassium	62	15.7	Joannis
Potassium nitrate	333.5	48.9	Person
Phenol	25.37	24.93	Petterson
Paraffin	52.40	35.10	Batelli
Silver	961	21.07	Person
Sodium	97	31.7	Joannis
Sodium nitrate	305.8	64.87	Joannis
phosphate	36.1	66.8	Joannis
Spermaceti	43.9	36.98	Batelli
Sulphur	115	9.37	Person
Tin	232	14.0	Mean
Wax (Bees')	61.8	42.3	Mean
Zinc	419	28.13	Mean

HEAT EQUIVALENT OF VAPORIZATION

The table gives the heat equivalent (or latent heat) of vaporization in calories per gram, at the temperature of ebullition, and at the pressure of the vapor for that temperature.

(Principally from the Smithsonian Tables.)

Substance.	Temp. °C.	Heat Cal/g.	Observer.
Acetic acid	118*	84.9	Ogier
Air	.....	50.97	Fenner-Richtmyer
Alcohol: amyl	131*	120	Schall
ethyl	78.1*	205	Wirtz
ethyl	0	236	Regnault
methyl	64.5*	267	Wirtz
methyl	0	289	Ramsay & Young
Ammonia	7.8	294.2	Regnault
Ammonia	11	291.3	Regnault
Ammonia	16	297.4	Regnault
Ammonia	17	296.5	Regnault
Benzene	80.1*	92.9	Wirtz
Bromine	61*	45.6	Andrews
Carbon dioxide, liq	− 25	72.23	Cailletet & Mathias
Carbon dioxide, liq	0	57.48	Cailletet & Mathias
Carbon dioxide, liq	12.35	44.97	Mathias
Carbon dioxide, liq	22.04	31.8	Mathias
Carbon dioxide, liq	29.85	14.4	Mathias
Carbon dioxide, liq	30.82	3.72	Mathias
Carbon disulphide	46.1*	83.8	Wirtz
Carbon disulphide	0	90	Regnault
Chloroform	60.9*	58.5	Wirtz
Ether	34.5*	88.4	Wirtz
Ether	34.9	90.5	Andrews
Ether	0	94	Regnault
Iodine	184*	23.95	Favre & Silbermann
Mercury	357*	65	Mean
Nitrogen	−195.6*	47.65	Alt
Oxygen	−182.9*	50.97	Alt
Sulphur dioxide	0	91.2	Cailletet & Mathias
Sulphur dioxide	30	80.5	Cailletet & Mathias
Sulphur dioxide	65	68.4	Cailletet & Mathias
Turpentine	159.3	74.04	Brix
Water	100	535.9	Andrews
Water	0	596.8	Dieterici, 1889
Water	20	585.3	Smith, 1908
Water	40	574.0	Henning, 1909
Water	60	562.9	Henning, 1909
Water	80	551.1	Henning, 1909
Water	100*	538.7	Henning, 1909
Water	120	525.3	Henning, 1909
Water	140	510.9	Henning, 1909
Water	160	496.6	Henning, 1909
Water	180	482.2	Henning, 1909

Temperature values marked * are those of normal ebullition, at 76 cm. pressure.

CHANGE IN VOLUME DUE TO FUSION

The table gives the variation in volume expressed in c.cm. for one gram of the substance.

Substance.	Variation, cm.	Observer.
Aluminum	+0.019	Toepler, 1894
Bismuth	−0.0034	Toepler, 1894
Cadmium	+0.0064	Toepler, 1894
Iron	−0.0085	Wrightson, Roberts, 1881
Lead	+0.0034	Toepler, 1894
Tin	+0.0039	Toepler, 1894
Water	−0.083*	Toepler, 1894
Zinc	+0.0105	Toepler, 1894

*For one cubic centimeter.

FIXED POINTS FOR THERMOMETER CALIBRATION

Substance	Point	Temperature Thermo. Scale. °C	Conditions
Hydrogen	Boils	−252.7	
Oxygen	Boils	−183.0	
Carbon dioxide	Sublimes	−78.5	
Mercury	Solidifies	−38.87	
Water	Melts	0.	
Ethyl alcohol	Boils	78.26	76 cm. variation 0.34° per cm.
Benzene	Boils	80.0	76 cm. variation 0.43° per cm.
Water	Boils	100.	76 cm. variation 0.37° per cm.
Chlorobenzene	Boils	132.	76 cm. variation 0.50° per cm.
Xylene (m.)	Boils	138.8	76 cm. variation 0.50° per cm.
Aniline	Boils	184.51	76 cm. variation 0.51° per cm.
Toluidine (o.)	Boils	199.7	76 cm. variation 0.58° per cm.
Naphthalene	Boils	218.	76 cm. variation 0.59° per cm.
Tin	Melts	231.9 ± 0.2	
Diphenylamine	Boils	302.	
Benzophenone	Boils	305.9 ± 0.1	76 cm.
Cadmium	Melts	320.9 ± 0.2	Graphite crucible in air.
Lead	Melts	327. ± 0.5	
Mercury	Boils	356.9	
Zinc	Melts	419.4 ± 0.3	Graphite crucible in air.
Sulfur	Boils	444.55	76 cm.
Antimony	Melts	630.0 ± 0.5	Graphite crucible in CO_2.
Aluminum	Solidifies	658.7 ± 0.6	Graphite crucible in CO_2.
Silver	Melts	960.5	Graphite crucible in CO_2.
Gold	Melts	1063.0	Graphite crucible in CO_2.
Copper	Melts	1083. ± 3	Graphite crucible in CO_2.
Li_2SiO_3	Melts	1201.0	Platinum crucible in air.
Nickel	Melts	1452.	Magnesia crucible in H and N_2
Cobalt	Melts	1480.	Magnesia crucible in air.
Palladium	Melts	1555.	Magnesia crucible in air.
Anorthite, pure	Melts	1549.5 ± 2	Platinum crucible in air.
Platinum	Melts	1755. ± 5	
Alumina	Melts	2000.	
Tungsten	Melts	3370.	

VAPOR TENSION OF WATER

Tension of Aqueous Vapor, −30 to 0° C., Over Water

The tension is given in millimeters of mercury at 0° C.

(From International Bureau of Weights and Measures.)

Temp. °C.	0.0	0.2	0.4	0.6	0.8
−30	0.3805				
−29	0.4185	0.4106	0.4028	0.3952	0.3878
−28	0.4598	0.4512	0.4428	0.4346	0.4265
−27	0.5047	0.4954	0.4862	0.4772	0.4684
−26	0.5535	0.5433	0.5333	0.5236	0.5141
−25	0.6064	0.5955	0.5847	0.5741	0.5637
−24	0.6637	0.6518	0.6402	0.6288	0.6175
−23	0.7258	0.7130	0.7003	0.6879	0.6757
−22	0.7930	0.7792	0.7655	0.7520	0.7388
−21	0.8656	0.8506	0.8359	0.8214	0.8071
−20	0.9441	0.9279	0.9120	0.8963	0.8808
−19	1.0288	1.0114	0.9941	0.9772	0.9605
−18	1.1202	1.1013	1.0828	1.0646	1.0465
−17	1.2187	1.1985	1.1785	1.1588	1.1394
−16	1.3248	1.3030	1.2814	1.2602	1.2393
−15	1.4390	1.4155	1.3924	1.3695	1.3470
−14	1.5618	1.5366	1.5117	1.4872	1.4629
−13	1.6939	1.6667	1.6399	1.6135	1.5874
−12	1.8357	1.8065	1.7776	1.7493	1.7214
−11	1.9880	1.9567	1.9258	1.8953	1.8653
−10	2.1514	2.1178	2.0847	2.0520	2.0198
− 9	2.3266	2.2905	2.2550	2.2199	2.1854
− 8	2.5143	2.4758	2.4378	2.4002	2.3632
− 7	2.7153	2.6740	2.6332	2.5930	2.5534
− 6	2.9304	2.8863	2.8427	2.7997	2.7572
− 5	3.1605	3.1132	3.0665	3.0205	2.9751
− 4	3.4065	3.3560	3.3062	3.2570	3.2084
− 3	3.6693	3.6153	3.5620	3.5095	3.4576
− 2	3.9499	3.8923	3.8355	3.7794	3.7240
− 1	4.2493	4.1878	4.1271	4.0672	4.0082
− 0	4.5687	4.5032	4.4385	4.3747	4.3116

VAPOR TENSION OF WATER

TENSION OF AQUEOUS VAPOR. 40 TO 0° C., OVER ICE

The tension is given in millimeters of mercury,
(Juhlin and Marvin.)

Temp. °C.	0.	1.	2.	3.	4.
−40	0.105	0.095	0.085	0.076	0.068
−30	0.292	0.264	0.238	0.215	0.193
−20	0.787	0.714	0.648	0.589	0.534
−10	1.974	1.806	1.650	1.506	1.375

Temp. °C.	5.	6.	7.	8.	9.
−40	0.061	0.054	0.048	0.043	0.038
−30	0.173	0.156	0.141	0.127	0.115
−20	0.484	0.438	0.397	0.358	0.324
−10	1.257	1.148	1.048	0.955	0.868

Temp. °C.	.0	.1	.2	.3	.4
−10	1.974	1.956	1.939	1.922	1.905
− 9	2.154	2.136	2.118	2.100	2.082
− 8	2.347	2.327	2.307	2.287	2.268
− 7	2.557	2.535	2.514	2.492	2.470
− 6	2.785	2.761	2.738	2.715	2.692
− 5	3.032	3.006	2.981	2.956	2.931
− 4	3.299	3.271	3.244	3.217	3.190
− 3	3.586	3.556	3.527	3.498	3.469
− 2	3.894	3.862	3.831	3.799	3.768
− 1	4.223	4.189	4.155	4.122	4.089
− 0	4.579	4.543	4.507	4.470	4.434

Temp. °C.	.5	.6	.7	.8	.9
−10	1.888	1.872	1.855	1.838	1.822
− 9	2.064	2.046	2.028	2.010	1.992
− 8	2.249	2.230	2.211	2.192	2.173
− 7	2.449	2.428	2.407	2.387	2.367
− 6	2.669	2.646	2.624	2.601	2.579
− 5	2.906	2.882	2.857	2.833	2.809
− 4	3.163	3.136	3.110	3.084	3.058
− 3	3.440	3.411	3.382	3.354	3.326
− 2	3.737	3.706	3.676	3.646	3.616
− 1	4.056	4.023	3.990	3.958	3.926
− 0	4.398	4.362	4.327	4.292	4.257

VAPOR TENSION OF WATER

TENSION OF AQUEOUS VAPOR, 0 TO 100° C.

The tension is given in millimeters of mercury at 0° C.
(International Bureau of Weights and Measures.)

Temp. ° C.	0.0	0.2	0.4	0.6	0.8
0	4.5687	4.6350	4.7022	4.7703	4.8393
1	4.9091	4.9798	5.0515	5.1240	5.1975
2	5.2719	5.3472	5.4235	5.5008	5.5790
3	5.6582	5.7383	5.8195	5.9017	5.9850
4	6.0693	6.1546	6.2410	6.3285	6.4171
5	6.5067	6.5974	6.6893	6.7824	6.8765
6	6.9718	7.0682	7.1658	7.2646	7.3647
7	7.4660	7.5685	7.6722	7.7772	7.8834
8	7.9909	8.0998	8.2099	8.3214	8.4342
9	8.5484	8.6641	8.7810	8.8993	9.0189
10	9.1398	9.2623	9.3863	9.5117	9.6387
11	9.7671	9.8969	10.028	10.161	10.296
12	10.432	10.570	10.709	10.850	10.993
13	11.137	11.283	11.430	11.580	11.731
14	11.884	12.038	12.194	12.352	12.512
15	12.674	12.837	13.003	13.170	13.339
16	13.510	13.683	13.858	14.035	14.214
17	14.395	14.578	14.763	14.950	15.139
18	15.330	15.524	15.719	15.917	16.117
19	16.319	16.523	16.730	16.939	17.150
20	17.363	17.579	17.997	18.018	18.241
21	18.466	18.694	18.924	19.157	19.392
22	19.630	19.870	20.113	20.359	20.607
23	20.858	21.111	21.367	21.626	21.888
24	22.152	22.420	22.690	22.963	23.239
25	23.517	23.799	24.084	24.371	24.662
26	24.956	25.252	25.552	25.855	26.161
27	26.471	26.783	27.099	27.418	27.740
28	28.065	28.394	28.727	29.062	29.401
29	29.744	30.090	30.440	30.793	31.149
30	31.510	31.873	32.341	32.612	32.988
31	33.366	33.749	34.136	34.526	34.920
32	35.318	35.720	36.126	36.536	36.951
33	37.369	37.791	38.218	38.649	39.084
34	39.523	39.966	40.414	40.866	41.323

VAPOR TENSION OF WATER (Continued)

TENSION OF AQUEOUS VAPOR, 0 TO 100° C.

In millimeters of mercury.

Temp. ° C.	0.0	0.2	0.4	0.6	0.8
35	41.784	42.250	42.720	43.195	43.674
36	44.158	44.646	45.139	45.637	46.140
37	46.648	47.160	47.677	48.200	48.727
38	49.259	49.796	50.339	50.886	51.439
39	51.997	52.560	53.128	53.702	54.281
40	54.865	55.455	56.051	56.652	57.258
41	57.870	58.488	59.111	59.741	60.376
42	61.017	61.664	62.316	62.975	63.640
43	64.310	64.987	65.670	56.359	67.055
44	67.757	68.465	69.180	69.901	70.628
45	71.362	72.102	72.850	73.603	74.364
46	75.131	75.906	76.687	77.475	78.270
47	79.071	79.880	80.696	81.520	82.350
48	83.188	84.034	84.886	85.746	86.614
49	87.488	88.371	89.261	90.159	91.064
50	91.978	92.900	93.829	94.766	95.711
51	96.664	97.626	98.595	99.573	100.56
52	101.55	102.56	103.57	104.59	105.62
53	106.65	107.70	108.76	109.82	110.89
54	111.97	113.06	114.16	115.27	116.39
55	117.52	118.65	119.80	120.95	122.12
56	123.29	124.48	125.67	126.87	128.09
57	129.31	130.54	131.79	133.04	134.30
58	135.58	136.86	138.15	139.46	140.77
59	142.10	143.43	144.78	146.14	147.51
60	148.88	150.27	151.68	153.09	154.51
61	155.95	157.39	158.85	160.32	161.80
62	163.29	164.79	166.31	167.83	169.37
63	170.92	172.49	174.06	175.65	177.25
64	178.86	180.48	182.12	183.77	185.43
65	187.10	188.79	190.49	192.20	193.93
66	195.67	197.42	199.18	200.96	202.75
67	204.56	206.38	208.21	210.06	211.92
68	213.79	215.68	217.58	219.50	221.43
69	223.37	225.33	227.30	229.29	231.29

VAPOR TENSION OF WATER (Continued)

TENSION OF AQUEOUS VAPOR, 0 TO 100° C.

In millimeters of mercury.

Temp. ° C.	0.0	0.2	0.4	0.6	0.8
70	233.31	235.34	237.39	239.45	241.52
71	243.62	245.72	247.85	249.98	252.14
72	254.30	256.49	258.69	260.91	263.14
73	265.38	267.65	269.93	272.23	274.54
74	276.87	279.21	281.58	283.96	286.35
75	288.76	291.19	293.64	296.11	298.59
76	301.09	303.60	306.14	308.69	311.26
77	313.85	316.45	319.07	321.72	324.38
78	327.05	329.75	332.47	335.20	337.95
79	340.73	343.52	346.33	349.16	352.01
80	354.87	357.76	360.67	363.59	366.54
81	369.51	372.49	375.50	378.53	381.58
82	384.64	387.73	390.84	393.97	397.12
83	400.29	403.49	406.70	409.94	413.19
84	416.47	419.77	423.09	426.44	429.81
85	433.19	436.60	440.04	443.49	446.97
86	450.47	454.00	457.54	461.11	464.71
87	468.32	471.96	475.63	479.32	483.03
88	486.76	490.52	494.31	498.12	501.95
89	505.81	509.69	513.60	517.53	521.48
90	525.47	529.48	533.51	537.57	541.65
91	545.77	549.90	554.07	558.26	562.47
92	566.71	570.98	575.28	579.61	583.96
93	588.33	592.74	597.17	601.64	606.13
94	610.64	615.19	619.76	624.37	629.00
95	633.66	638.35	643.06	647.81	652.59
96	657.40	662.23	667.10	672.00	676.92
97	681.88	686.87	691.89	696.93	702.02
98	707.13	712.27	717.44	722.65	727.89
99	733.16	738.46	743.80	749.17	754.57
100	760.00	765.47	770.97	776.50	782.07

VAPOR TENSION OF WATER

Tension of Aqueous Vapor, 100–230° C.

Giving the vapor tension in millimeters of mercury, in pounds per square inch and the corresponding temperature Fahrenheit.

(From Regnault—Smithsonian Tables.)

Temp.* ° C.	Pressure. mm.	Pressure. Pounds per sq.in.	Temp.* ° F.	Temp.* ° C.	Pressure. mm.	Pressure. Pounds per sq.in.	Temp.* ° F.
100	760.00	14.70	212.0	145	3125.55	60.44	293.0
101	787.59	15.23	213.8	146	3212.74	62.13	294.8
102	816.01	15.79	215.6	147	3301.87	63.86	296.6
103	845.28	16.35	217.4	148	3392.98	65.62	298.4
104	875.41	16.94	219.2	149	3486.09	67.41	300.2
105	906.41	17.53	221.0	150	3581.2	69.26	302.0
106	938.31	18.15	222.8	151	3678.4	71.14	303.8
107	971.14	18.78	224.6	152	3777.7	73.06	305.6
108	1004.91	19.44	226.4	153	3879.2	75.02	307.4
109	1039.65	20.11	228.2	154	3982.8	77.03	309.2
110	1075.37	20.80	230.0	155	4088.6	79.07	311.0
111	1112.09	21.51	231.8	156	4196.6	81.22	312.8
112	1149.83	22.24	233.6	157	4306.9	83.29	314.6
113	1188.61	22.99	235.4	158	4419.5	85.47	316.4
114	1228.47	23.76	237.2	159	4534.4	87.69	318.2
115	1269.41	24.55	239.0	160	4651.6	89.96	320.0
116	1311.47	25.37	240.8	161	4771.3	92.27	321.8
117	1354.66	26.20	242.6	162	4893.4	94.63	323.6
118	1399.02	27.06	244.4	163	5017.9	97.04	325.4
119	1444.55	27.94	246.2	164	5145.0	99.50	327.2
120	1491.28	28.85	248.0	165	5274.5	102.01	329.0
121	1539.25	29.78	249.8	166	5406.7	104.56	330.8
122	1588.47	30.73	251.6	167	5541.4	107.18	332.6
123	1638.96	31.70	253.4	168	5678.8	109.84	334.4
124	1690.76	32.70	255.2	169	5818.9	112.53	336.2
125	1743.88	33.72	257.0	170	5961.7	115.29	338.0
126	1798.35	34.78	258.8	171	6107.2	118.11	339.8
127	1854.20	35.86	260.6	172	6255.5	120.98	341.6
128	1911.47	36.97	262.4	173	6406.6	123.90	343.4
129	1970.15	38.11	264.2	174	6560.6	126.87	345.2
130	2030.28	39.26	266.0	175	6717.4	129.91	347.0
131	2091.94	40.47	267.8	176	6877.2	133.00	348.8
132	2155.03	41.68	269.6	177	7040.0	136.15	350.6
133	2219.69	42.93	271.4	178	7205.7	139.35	352.4
134	2285.92	44.21	273.2	179	7374.5	142.62	354.2
135	2353.73	45.52	275.0	180	7546.4	145.93	356.0
136	2423.16	46.87	276.8	181	7721.4	149.32	357.8
137	2494.23	48.24	278.6	182	7899.5	152.77	359.6
138	2567.00	49.65	280.4	183	8080.8	156.32	361.4
139	2641.44	51.06	282.2	184	8265.4	159.84	363.2
140	2717.63	52.55	284.0	185	8453.2	163.47	365.0
141	2795.57	54.07	285.8	186	8644.4	167.17	366.8
142	2875.30	55.60	287.6	187	8838.8	170.94	368.6
143	2956.86	57.16	289.4	188	9036.7	174.76	370.4
144	3040.26	58.79	291.2	189	9238.0	178.65	372.2

* These are the temperatures at which water boils under pressures shown.

VAPOR TENSION OF WATER (Continued)

TENSION OF AQUEOUS VAPOR, 100–230° C.

Giving the vapor tension in millimeters of mercury, in pounds per square inch and the corresponding temperature Fahrenheit.)

(From Regnault—Smithsonian Tables.)

Temp. ° C.	Pressure.		Temp. ° F.	Temp. ° C.	Pressure.		Temp. ° F.
	mm.	Pounds per sq.in.			mm.	Pounds. per sq.in.	
190	9442.7	182.61	374.0	210	14324.8	277.01	410.0
191	9650.9	186.63	375.8	211	14611.3	282.58	411.8
192	9862.7	190.72	377.6	212	14902.2	288.21	413.6
193	10078.0	194.88	379.4	213	15197.5	293.92	415.4
194	10297.0	199.13	381.2	214	15497.2	299.72	417.2
195	10519.6	203.43	383.0	215	15801.3	305.57	419.0
196	10746.0	207.81	384.8	216	16109.9	311.57	420.8
197	10975.0	212.25	386.6	217	16423.2	317.62	422.6
198	11209.8	216.77	388.4	218	16740.9	323.78	424.4
199	11447.5	221.37	390.2	219	17063.3	330.01	426.2
200	11689.0	226.04	392.0	220	17390.4	336.30	428.0
201	11934.4	230.79	393.8	221	17722.1	342.70	429.8
202	12183.7	235.61	395.6	222	18058.6	349.21	431.6
203	12437.0	240.54	397.4	223	18399.9	355.81	433.4
204	12694.3	245.49	399.2	224	18746.1	362.50	435.2
205	12955.7	250.53	401.0	225	19097.0	369.29	437.0
206	13221.1	255.67	402.8	226	19452.9	376.17	438.8
207	13490.8	260.88	404.6	227	19813.8	383.15	440.6
208	13764.5	266.18	406.4	228	20179.6	390.22	442.4
209	14042.5	271.55	408.2	229	20550.5	397.40	444.2

VAPOR TENSION OF MERCURY

(From Gebhardt, Hertz, Regnault, Van der Plaats, and others.)

Temp. ° C.	Pressure, mm.	Temp. ° C.	Pressure, mm.
0	0.0004	200	18.3
20	0.0013	220	33.7
40	0.006	240	59.
60	0.03	260	98
80	0.09	280	156.
100	0.28	300	246.
120	0.8	320	371.
140	1.85	340	548.
160	4.4	360	790.
180	9.2		

LOWERING OF VAPOR PRESSURE BY SALTS IN AQUEOUS SOLUTIONS

The table gives the reduction of the vapor pressure in millimeters due to the presence of the number of grammolecules of salt per liter of water given at the head of the columns, at the temperature 100° C., at which temperature the vapor pressure of pure water is 76.0 centimeters.

(From Smithsonian Tables.)

Substance	0.5	1.0	2.0	3.0	4.0	5.0	6.0	8.0	10.0
Ammonium chloride.	12.0	23.7	45.1	69.3	94.2	118.5	138.2	179.0	213.8
Barium chloride.....	16.4	36.7	77.6						
Calcium chloride....	17.0	39.8	95.3	166.6	241.5	319.5			
Ferrous sulphate....	5.8	10.7	24.0	42.4					
Potassium hydroxide.	15.0	29.5	64.0	99.2	140.0	181.8	223.0	309.5	387.8
Potassium iodide....	12.5	25.3	52.2	82.6	112.2	141.5	171.8	225.5	278.5
Sodium chloride.....	12.3	25.2	52.1	80.0	111.0	143.0	176.5		
Sodium hydroxide...	11.8	22.8	48.2	77.3	107.5	139.1	172.5	243.3	314.0
Sulphuric acid.....	12.9	26.5	62.8	104.0	148.0	198.4	247.0	343.2	
Zinc sulphate.....	4.9	10.4	21.5	42.1	66.2				

CONSTANTS OF THE KINETIC THEORY OF GASES

Giving the velocity, mean free path and diameter of molecules for various gases and vapors at 0° C. and 760 mm. pressure.

Gas.	Mean vel. cm./s.	Mean free path, cm.	Diam. cm.	Observer.
Ammonia.....	5.8×10^{4}	6.2×10^{-6}	3.9×10^{-8}	Graham, 1846
Argon.....	3.81	8.84	3.23	Schultze, 1901
Benzene.....	2.7	21	6.6	
Carbon dioxide	3.6	5.6	4.1	Breitenbach 1899
Chlorine.....	2.86	4.07	4.76	Graham, 1846
Chloroform...	2.2	2.3	6.3	Puluj, 1878
Ether.....	2.8	2.1	6.6	Puluj, 1878
Ethyl alcohol.	3.5	3.2	5.3	Puluj, 1878
Helium.....	12.02	25.1	1.9	Schultze, 1901
Hydrogen....	16.94	16.3	2.38	Puluj, 1878
Nitrogen.....	4.53	8.61	3.27	Markowski, 1904
Oxygen.....	4.25	9.06	3.19	Markowski, 1904
Water vapor..	5.7	5.7	4.0	Puluj, 1878

NUMBER OF MOLECULES IN A GRAM-MOLECULE

Perrin, 1909–11	6.2×10^{23}
Perrin (Brownian movement)	6.85
Millikan, 1910	6.2
Millikan, 1917	6.06

MASS OF THE HYDROGEN ATOM

1.66×10^{-24} grams

VAPOR PRESSURES OF

In centimeters

(Principally from

Temp. ° C.	Carbon bisulphide, CS_2.	Carbon dioxide, CO_2.	Carbon tetrachloride, CCl_4.	Chloroform, $CHCl_3$.	Ethyl Alcohol, C_2H_6O.	Ethyl Ether, $C_4H_{10}O$.	Acetic acid.	Acetone, C_3H_6O.	Ammonia, NH_3.
−30	....	.....	....	....	....	....	....	....	86.61
−25	....	1300.70	....	....	....	....	....	....	110.43
−20	4.73	1514.24	.98	....	.33	6.89	....	....	139.21
−15	6.16	1758.25	1.35	....	.51	8.93	....	....	173.65
−10	7.94	2034.02	1.85	....	.65	11.47	....	....	214.46
− 5	10.13	2344.13	2.48	....	.91	14.61	....	....	264.42
0	12.79	2690.66	3.29	5.97	1.27	18.44	0.35	....	318.33
5	16.00	3075.38	4.32	....	1.76	23.09	....	....	383.03
10	19.85	3499.86	5.60	10.05	2.42	28.68	0.64	....	457.40
15	24.41	3964.69	7.17	....	3.30	35.36	....	....	543.34
20	29.80	4471.66	9.10	16.05	4.45	43.28	1.18	17.96	638.78
25	36.11	5020.73	11.43	20.02	5.94	52.59	....	22.63	747.70
30	43.46	5611.90	14.23	24.75	7.85	63.43	2.01	28.10	870.10
35	51.97	6244.73	17.55	30.35	10.29	76.12	....	34.52	1007.02
40	61.75	6918.44	21.48	36.93	13.37	90.70	3.42	42.01	1159.53
45	72.95	7631.46	26.08	44.60	17.22	107.42	....	50.75	1328.73
50	85.71	.....	31.44	53.50	21.99	126.48	5.63	62.29	1515.83
55	100.16	.....	37.63	63.77	27.86	148.11	....	72.59	1721.98
60	116.45	.....	44.74	75.54	35.02	172.50	8.83	86.05	1948.21
65	134.75	.....	52.87	88.97	43.69	199.89	....	101.43	2196.51
70	155.21	.....	62.11	104.21	54.11	230.49	13.70	118.94	2467.55
75	177.99	.....	72.57	121.42	66.55	264.54	....	138.76	2763.00
80	203.25	.....	84.33	140.76	81.29	302.28	20.23	161.10	3084.31
85	231.17	.....	97.51	162.41	98.64	343.95	....	186.18	3433.09
90	261.91	.....	112.23	186.52	118.93	389.83	29.27	214.17	3810.92
95	296.63	.....	128.69	213.28	142.51	440.18	....	245.28	4219.57
100	332.51	.....	146.71	242.85	169.75	495.33	41.7	279.73	4660.82
105	372.72	.....	166.72	275.40	201.04	555.62	....	317.70	.....
110	416.41	.....	188.74	311.10	236.76	621.46	....	359.40	.....
115	463.74	.....	212.91	350.10	277.34	693.33	58.2	405.00	.....
120	514.88	.....	239.37	392.57	323.17	771.92	....	454.69	.....
							79.4		
125	569.97	.....	268.24	438.66	374.69	....	....	508.62	.....
130	629.16	.....	299.69	488.51	432.30	....	106.7	566.97	.....
135	692.59	.....	333.86	542.25	496.42	....	....	629.87	.....
140	760.40	.....	370.90	600.02	567.46	....	140.4	697.44	.....
145	832.69	.....	411.00	661.92	645.80	....	....	....	.....
150	909.59	.....	454.31	728.06	731.84	....	184.7	....	.....
155	....	.....	501.02	798.53	825.92	....	....	....	.....
160	....	.....	551.31	873.42	....	....	....	....	.....
165	....	.....	605.38	952.78	....	....	....	....	.....

VARIOUS SUBSTANCES

of mercury.

Regnault.)

Temp. ° C.	Benzol, C_6H_6.	Camphor.	Methyl alcohol, CH_4O.	Naphthalene.	Nitrous oxide, N_2O.	Pictet's fluid, $64SO_2+44CO_2$ by weight.	Sulphur dioxide, SO_2.	Hydrogen sulphide, H_2S.	Terpentine, $C_{10}H_{16}$.
−30	....	....	....	....	.....	58.52	28.75		
−25	....	....	.41	....	1569.49	67.64	37.38	374.93	
−20	.58	....	.63	....	1758.66	74.48	47.95	443.85	
−15	.88	....	.93	....	1968.43	89.68	60.79	519.65	
−10	1.29	....	1.35	....	2200.80	101.84	76.25	608.46	
− 5	1.83	....	1.92	....	2457.92	121.60	94.69	706.60	
0	2.53	0.006	2.68	0.002	2742.10	139.08	116.51	820.63	.21
5	3.42	....	3.69	....	3055.86	167.20	142.11	949.08	
10	4.52	0.010	5.01	0.005	3401.91	193.80	171.95	1089.63	.29
15	5.89	....	6.71	0.005	3783.17	226.48	206.49	1244.79	
20	7.56	0.015	8.87	0.008	4202.79	258.40	246.20	1415.15	.44
25	9.59	....	11.60	....	4664.14	297.92	291.60	1601.24	
30	12.02	0.026	15.00	0.013	5170.85	338.20	343.18	1803.53	.69
35	14.93	....	19.20	....	6335.98	383.80	401.48	2002.43	
40	18.36	0.060	24.35	0.032	.....	434.72	467.02	2258.25	1.08
45	22.41	....	30.61	....	.....	478.80	540.35	2495.43	
50	27.14	0.130	38.17	0.081	.....	521.36	622.00	2781.48	1.70
55	32.64	....	47.22	....	.....	....	712.50	3069.07	
60	39.01	0.255	57.99	0.183	.....	....	812.38	3374.02	2.65
65	46.34	....	70.73	....	.....	....	922.14	3696.15	
70	54.74	0.460	85.71	0.395	.....	....	....	4035.32	4.06
75	64.32	....	103.21						
80	75.19	0.915	123.85	0.74	.....	....	....	.....	6.13
85	87.46	....	147.09						
90	101.27	....	174.17	1.26	.....	....	....	.....	9.06
95	116.75	....	205.17						
100	134.01	....	240.51	1.85	.....	....	....	.....	13.11
105	153.18	....	280.63						
110	174.44	....	325.96	2.73	.....	....	....	.....	18.60
115	197.82	....	376.98						
120	223.54	....	434.18	4.02	.....	....	....	.....	25.70
125	251.71	....	498.05						
130	282.43	....	569.13	6.19	.....	....	....	.....	34.90
135	315.85	....	647.93						
140	352.07	....	733.71	....	.....	....	....	.....	46.40
145	391.21	....	830.89	....					
150	433.37	....	936.13						
155	478.65	....	....	....	.....	....	....	.....	60.50
160	527.14	....	....	....	.....	....	....	.....	68.60
165	568.30	....	....	....	.....	....	....	.....	77.50

HEAT CONDUCTIVITY

Giving the quantity of heat in calories which is transmitted per second through a plate one centimeter thick across an area of one square centimeter when the temperature difference is one degree Centigrade.

METALS

Substance	Temp. °C.	Conductivity	Observer
Aluminum	−160	0.514	Lees, 1908
	18	0.480	Jaeger & Diesselhorst, 1900
	18	0.504	Lees, 1908
	100	0.492	Jaeger & Diesselhorst, 1900
	100	0.49	Angell, 1911
	200	0.55	"
	300	0.64	"
	400	0.76	"
	600	1.01	"
Antimony	0	0.0442	Lorenz, 1881
	100	0.040	"
	0–30	0.042	Berget, 1890
Bismuth	−186	0.025	Macchia, 1907
	0	0.0177	Lorenz
	18	0.0194	Jaeger & Diesselhorst, 1900
	100	0.0161	Jaeger & Diesselhorst, 1900
Brass (70Cu+30Zn)	−160	0.181	Lees, 1908
(70Cu+30Zn)	17	0.260	" "
yellow	0	0.204	Lorenz
red	0	0.246	"
Bronze, aluminum (90Cu, 10Al)	.....	0.18	Van Aubel
Cadmium	−160	0.239	Lees, 1908
	0	0.220	Lorenz
	18	0.222	Jaeger & Diesselhorst, 1900
	100	0.216	Jaeger & Diesselhorst, 1900
Constantan	18	0.054	Jaeger & Diesselhorst, 1900
(60Cu, 40Ni)	100	0.064	Jaeger & Diesselhorst, 1900
Copper, pure	−160	1.097	Lees, 1908
	13	1.00	Angström, 1863
	18	0.918	Jaeger & Diesselhorst, 1900

HEAT CONDUCTIVITY (Continued)

METALS

Substance	Temp. °C.	Conductivity	Observer
Copper, pure	100	0.908	Jaeger & Diesselhorst, 1900
	100–197	1.043	Hering, 1910
	100–268	0.969	"
	100–370	0.931	"
	100–541	0.902	"
	100–837	0.858	"
German silver	0	0.070	Lorenz, 1881
	100	0.089	"
(52Cu, 26Zn, 22Ni)	.....	0.10	Glage, 1905
Gold	17	0.705	Barratt, 1914
	18	0.700	Jaeger & Diesselhorst, 1900
	100	0.703	Jaeger & Diesselhorst, 1900
Iridium	17	0.141	Barratt, 1914
Iron, pure	18	0.161	Jaeger & Diesselhorst
	100	0.151	" "
	100–727	0.202	Hering, 1910
	100–1245	0.191	"
wrought	−160	0.152	Lees, 1908
	18	0.144	Jaeger & Diesselhorst
	100	0.143	" "
cast	18	0.109	" "
	100	0.108	" "
	54	0.114	Callendar
	102	0.111	"
Steel	−160	0.113	Lees, 1908
	18	0.115	" "
	18	0.108	Jaeger & Diesselhorst
	100	0.107	" "
Lead	−160	0.092	Lees, 1908
	18	0.083	Jaeger & Diesselhorst
	100	0.082	" "
Magnesium	0–100	0.376	Lorenz, 1881
Manganin	18	0.15186	Jaeger & Diesselhorst
(84Cu, 4Ni, 12Mn)	100	0.06310	" "
	−160	0.035	Lees, 1908
Mercury	0	0.0148	H. F. Weber, 1880
	50	0.0189	" "
	17	0.0197	R. Weber, 1902
Molybdenum	17	0.346	Barratt, 1914
Nickel	−160	0.129	Lees, 1908

HEAT CONDUCTIVITY (Continued)

METALS

Substance	Temp. °C.	Conductivity	Observer
Nickel	18	0.142	Jaeger & Diesselhorst, 1900
	100	0.138	Jaeger & Diesselhorst, 1900
	300	0.126	Angell, 1911
	600	0.088	"
	800	0.068	"
	1200	0.058	"
Palladium	18	0.1683	Jaeger & Diesselhorst, 1900
	100	0.182	
Platinum	18	0.1664	Jaeger & Diesselhorst, 1900
	100	0.1733	Jaeger & Diesselhorst, 1900
Platinum-iridium 10% Ir	17	0.074	Barratt, 1914
Platinum-rhodium 10% Rh	17	0.072	Barratt, 1914
Platinoid	18	0.060	Lees, 1908
Rhodium	17	0.210	Barratt, 1914
Silver, pure	−160	0.998	Lees, 1908
	18	0.974	"
	18	1.006	Jaeger & Diesselhorst, 1900
	100	0.992	Jaeger & Diesselhorst, 1900
Tin	−160	0.192	Lees, 1908
	0	0.1528	Lorenz, 1881
	18	0.155	Jaeger & Diesselhorst, 1900
	100	0.145	Jaeger & Diesselhorst, 1900
	100	0.1423	Lorenz, 1881
Tantalum	17	0.130	Barratt, 1914
Tungsten	17	0.476	"
	18	0.35	Coolidge
Wood's alloy	.....	0.0319	H. F. Weber
Zinc	−160	0.278	Lees, 1908
	18	0.2653	Jaeger & Diesselhorst
	100	0.2619	" " "

HEAT CONDUCTIVITY (Continued)

VARIOUS SOLIDS

Approximate values at ordinary temperatures.

Substance	Conductivity	Observer
Asbestos fiber, 500° C.	0.00019	Randolph, 1912
paper	0.0006	.....
	0.0004	Lees-Chorlton, 1896
Basalt	0.0052	Hecht, 1903
Brick, common red	0.0015	Herschel-Lebour & Dunn, 1879
Blotting paper	0.00015	Lees-Charlton, 1896
Carbon	0.01	
Carborundum	0.0005	Lorenz
brick, 150°–1200°	0.032–0.027	Wologdine
Cardboard	0.0005	.....
Cement, Portland	0.00071	Lees-Chorlton, 1896
Chalk	0.0020	Herschel-Lebour & Dunn, 1879
Concrete, cinder	0.00081	.....
stone	0.0022	Norton
Cork	0.00072	G. Forbes, 1875
	0.00013	Lees, 1892–8
Cotton wool	0.000043	G. Forbes
felted	0.000033	"
Diatomic earth	0.00013	Hutton-Blard
Earth's crust, ave.	0.004	.....
Ebonite	0.00042	Lees
	0.00014	Barratt, 1914
Eiderdown	0.000011	Peclet, 1878
Felt	0.000087	.....
Fiber, red	0.0011	Barratt, 1914
Fire brick	0.00028	Hutton-Blard
	0.0011	Barratt, 1914
Flannel	0.00023	
Gas carbon, 20°	0.0085	Barratt, 1914
100°	0.0095	"
Glass		
crown (window)	0.0025	Lees, 1892–8
flint	0.002	"
Jena	0.001–0.002	"
soda, 20°	0.0017	Barratt, 1914
100°	0.0018	"
Granite, 100°	0.0045–0.0050	Poole, 1912
500°	0.0040	"
Graphite	0.012	.....
Graphite brick, 300° to 700°	0.24	Wologdine, 1909

HEAT CONDUCTIVITY (Continued)

VARIOUS SOLIDS (Continued)

Approximate values at ordinary temperatures.

Substance	Conductivity	Observer
Gutta percha	0.00048	Péclet, 1878
Gypsum	0.0031	R. Weber, 1878
Haircloth, felt	0.000042	G. Forbes
Ice	0.005	.....
	0.0039	.....
	0.0022	Forbes, 1875
Infusorial earth, 100°	0.00034	Skinner
300°	0.00040	"
pressed bricks, 100°	0.00030	"
Lamp black, 100	0.00007	Randolph, 1912
Leather, cowhide	0.00042	Lees-Chorlton, 1896
chamois	0.00015	" "
Lime	0.00029	Hutton-Blard
Linen	0.00021	Lees-Chorlton, 1896
Magnesia, MgO	0.00016–0.00045	Hutton-Blard
brick, 50°–1130°	0.0027–0.0072	Wologdine, 1909
Magnesium carbonate, 100°	0.00023	Skinner
300°	0.00025	"
Marble	0.0071	Lees, 1892–8
Mica, perpendicular to cleavage plane	0.0018	Lees
Paper	0.0003	"
Paraffine	0.0006	"
0°	0.00023	R. Weber, 1878
Plaster of Paris	0.00070	Lees-Chorlton, 1896
Porcelain	0.0025	Lees, 1892–8
165°–1055°	0.0039–0.0047	Wologdine, 1909
Quartz, parallel to axis	0.030	Lees, 1892–8
perpendicular to axis	0.16	"
Rubber, para	0.00045	"
Sand, dry	0.00093	Herschel-Lebour & Dunn, 1879
Sandstone	0.0055	Herschel-Lebour & Dunn, 1879
Sawdust	0.00012	G. Forbes, 1875
Silica, fused, 20°	0.00237	Barratt, 1914
100°	0.00255	"
Silica brick, 100° to 1000° C	0.002–0.003	Wologdine, 1909
Silk	0.000095	Lees-Chorlton, 1896
Slate	0.004700	Lees, 1892–8

HEAT CONDUCTIVITY (Continued)

VARIOUS SOLIDS (Continued)

Approximate values at ordinary temperatures.

Substance	Conductivity	Observer
Snow, compact	0.00051	Hjeltström
Soil, dry	0.00033	Lees-Chorlton, 1896
Wax, bees'	0.00009	G. Forbes
Wood, fir || to axis	0.00030	.....
perpendicular to axis.	0.00009	.....

LIQUIDS

Acetic acid	0.00047	H. F. Weber
Amyl alcohol	0.000328	"
Aniline, 12°	0.00041	.....
Benzole, 5°	0.000333	H. F. Weber
Carbon disulphide, 9° to 15°	0.000343	"
Chloroform, 9° –15°	0.000288	"
Ether, 9°–15°	0.000303	"
Ethyl alcohol	0.000423	"
Glycerine, 9°–15°	0.000637	Graetz
Methyl alcohol	0.000495	H. F. Weber
Oils: olive	0.000395	Wachsmuth
castor	0.000425	"
petroleum, 13°	0.000355	Graetz
turpentine	0.000325	"
Vaseline, 25°	0.00044	Lees
Water, 4°	0.00138	H. F.Weber
0°	0.00120	"
17°	0.00131	R. Weber
20°	0.00143	Milner & Chattock

GASES

Air, 0°	0.0000568	Winklemann
Argon, 0°	0.0000389	Schwarze
Ammonia gas, 0°	0.0000458	Winklemann
Carbon dioxide, 0°	0.0000307	"
monoxide	0.0000499	"
Ethylene	0.0000395	"
Helium, 0°	0.000339	Schwarze
Hydrogen, 0°	0.000327	Winklemann
100°	0.000369	Graetz
Methane, 7°–8°	0.0000647	Winklemann
Nitric oxide, NO, 8°	0.0000460	"
Nitrogen, 7°–8°	0.0000524	"
Nitrous oxide, N_2O	0.0000350	
Oxygen, 7°–8°	0.0000563	

PROPERTIES OF

METRIC AND

The heat units used are the large calorie, 15° to 16° C. and the B.T.U., 62° to 3° F. The heat of the liquid, q, is the heat required to raise unit mass of water rom 0° C. (32° F.) to the temperature indicated. The heat of vaporization, r, s the heat required to vaporize unit mass of water at the indicated temperature nd pressure. Total heat involved, $H = r + q$.

The heat of vaporization overcomes external pressure and changes the state rom liquid to vapor at constant temperature and pressure. If u is the change

Temperature degrees Centigrade.	Pressure.			Heat of the liquid.		Heat of vaporization.		Heat equivalent of internal work.		Temperature, degrees Fahrenheit.
	Millimeters of mercury.	Kilograms per square centimeter.	Pounds per square inch.	Calories per kilogram.	B.T.U. per pound.	Calories per kilogram.	B.T.U. per pound.	Calories per kilogram.	B.T.U. per pound.	
t	p	p	p	q	q	r	r	ρ	ρ	t
0	4.579	0.00623	0.0886	0.00	0.0	595.4	1071.7	565.3	1017.5	**32**
1	4.924	0.00670	0.0952	1.01	1.8	594.9	1070.8	564.7	1016.4	**33.8**
2	5.290	0.00719	0.1023	2.02	3.6	594.4	1069.9	564.0	1015.3	**35.6**
3	5.681	0.00772	0.1099	3.03	5.5	593.9	1069.0	563.4	1014.2	**37.4**
4	6.097	0.00829	0.1179	4.03	7.3	593.3	1068.0	562.8	1013.1	**39.2**
5	6.541	0.00889	0.1265	5.04	9.1	592.8	1067.1	562.2	1011.9	**41**
6	7.011	0.00953	0.1356	6.04	10.9	592.3	1066.1	561.5	1010.7	**42.8**
7	7.511	0.01021	0.1453	7.05	12.7	591.8	1065.2	560.9	1009.6	**44.6**
8	8.042	0.01093	0.1555	8.05	14.5	591.2	1064.2	560.2	1008.5	**46.4**
9	8.606	0.01170	0.1664	9.05	16.3	590.7	1063.3	559.6	1007.4	**48.2**
10	9.205	0.01252	0.1780	10.06	18.1	590.2	1062.3	559.0	1006.2	**50**
11	9.840	0.01338	0.1903	11.06	19.9	589.6	1061.3	558.3	1005.0	**51.8**
12	10.513	0.01429	0.2033	12.06	21.7	589.1	1060.4	557.7	1003.9	**53.6**
13	11.226	0.01526	0.2171	13.06	23.5	588.6	1059.4	557.1	1002.7	**55.4**
14	11.980	0.01629	0.2317	14.06	25.3	588.1	1058.5	556.5	1001.6	**57.2**
15	12.779	0.01737	0.2471	15.06	27.1	587.6	1057.6	555.9	1000.5	**59**
16	13.624	0.01852	0.2635	16.06	28.9	587.0	1056.6	555.2	999.4	**60.8**
17	14.517	0.01974	0.2807	17.06	30.7	586.5	1055.7	554.6	998.3	**62.6**
18	15.460	0.02102	0.2990	18.06	32.5	585.9	1054.7	553.9	997.1	**64.4**
19	16.456	0.02237	0.3182	19.06	34.3	585.4	1053.8	553.3	996.0	**66.2**
20	17.51	0.02381	0.3386	20.06	36.1	584.9	1052.8	552.7	994.8	**68**
21	18.62	0.02532	0.3601	21.06	37.9	584.4	1051.9	552.1	993.7	**69.8**
22	19.79	0.02691	0.3827	22.06	39.7	583.9	1051.0	551.5	992.6	**71.6**
23	21.02	0.02858	0.4065	23.06	41.5	583.3	1050.0	550.8	991.4	**73.4**
24	22.32	0.03035	0.4316	24.06	43.3	582.8	1049.1	550.2	990.3	**75.2**
25	23.69	0.03221	0.4581	25.05	45.1	582.3	1048.1	549.5	989.1	**77**
26	25.13	0.03417	0.4860	26.05	46.9	581.8	1047.2	548.9	988.0	**78.8**
27	26.65	0.03623	0.5154	27.05	48.7	581.2	1046.2	548.2	986.9	**80.6**
28	28.25	0.03841	0.5463	28.05	50.5	580.7	1045.2	547.6	985.7	**82.4**
29	29.94	0.04071	0.5790	29.04	52.3	580.2	1044.3	547.0	984.6	**84.2**
30	31.71	0.04311	0.6132	30.04	54.1	579.6	1043.3	546.3	983.4	**86**

SATURATED STEAM

ENGLISH UNITS

in volume the external work is pu and the corresponding amount of heat is Apu, where A is the reciprocal of the mechanical equivalent of heat. The part of the heat of vaporization not used in external work is considered used in changing the state from liquid to vapor. The heat required for this work may be represented by $\rho = r - Apu$.

(From Peabody, Steam and Entropy Tables, John Wiley and Sons, Inc., publishers, by permission.)

Temperature, degrees Centigrade. t	Heat equivalent of external work. Calories per kilogram. Apu	Heat equivalent of external work. B.T.U. per pound. Apu	Entropy of the liquid. θ	Entropy of vaporization. $\frac{r}{T}$	Specific volume. Cubic meters per kilo. s	Specific volume. Cubic feet per pound. s	Density. Kilos per cubic meter. $\frac{1}{s}$	Density. Pounds per cubic foot. $\frac{1}{s}$	Temperature, degrees Fahrenheit. t
0	30.1	54.2	0.0000	2.1804	206.3	3304	0.00485	0.000303	32
1	30.2	54.4	0.0037	2.1706	192.7	3087	0.00519	0.000324	33.8
2	30.4	54.6	0.0074	2.1609	180.0	2884	0.00556	0.000347	35.6
3	30.5	54.8	0.0110	2.1513	168.2	2694	0.00595	0.000371	37.4
4	30.5	54.9	0.0146	2.1416	157.2	2518	0.00636	0.000397	39.2
5	30.6	55.2	0.0183	2.1320	147.1	2356	0.00680	0.000424	41
6	30.8	55.4	0.0219	2.1225	137.7	2206	0.00726	0.000453	42.8
7	30.9	55.6	0.0256	2.1130	129.0	2067	0.00775	0.000484	44.6
8	31.0	55.7	0.0290	2.1036	120.9	1937	0.00827	0.000516	46.4
9	31.1	55.9	0.0326	2.0943	113.4	1816	0.00882	0.000551	48.2
10	31.2	56.1	0.0361	2.0850	106.3	1703	0.00941	0.000587	50
11	31.3	56.3	0.0397	2.0758	99.8	1599	0.01002	0.000625	51.8
12	31.4	56.5	0.0433	2.0667	93.7	1502	0.01067	0.000666	53.6
13	31.5	56.7	0.0467	2.0576	88.1	1411	0.01135	0.000709	55.4
14	31.6	56.9	0.0502	2.0486	82.9	1327	0.01206	0.000754	57.2
15	31.7	57.1	0.0537	2.0396	77.9	1248	0.01283	0.000801	59
16	31.8	57.3	0.0571	2.0308	73.3	1174	0.01364	0.000852	60.8
17	31.9	57.4	0.0607	2.0220	69.1	1105	0.01447	0.000905	62.6
18	32.0	57.6	0.0641	2.0132	65.1	1041	0.01536	0.000961	64.4
19	32.1	57.8	0.0675	2.0045	61.3	982	0.01631	0.001018	66.2
20	32.2	58.0	0.0709	1.9959	57.8	926	0.01730	0.001080	68
21	32.3	58.2	0.0743	1.9873	54.5	873	0.01835	0.001145	69.8
22	32.4	58.4	0.0776	1.9788	51.5	824	0.01942	0.001214	71.6
23	32.5	58.6	0.0811	1.9703	48.60	778	0.02058	0.001286	73.4
24	32.6	58.8	0.0845	1.9620	45.92	735	0.02178	0.001361	75.2
25	32.8	59.0	0.0878	1.9536	43.40	695	0.02304	0.001439	77
26	32.9	59.2	0.0911	1.9453	41.05	657	0.02436	0.001522	78.8
27	33.0	59.3	0.0945	1.9370	38.83	622	0.02575	0.001608	80.6
28	33.1	59.5	0.0978	1.9288	36.74	589	0.02722	0.001698	82.4
29	33.2	59.7	0.1011	1.9207	34.78	557	0.02875	0.001795	84.2
30	33.3	59.9	0.1044	1.9126	32.95	528	0.03035	0.001894	86

PROPERTIES OF

Temperature, degrees Centigrade.	Pressure.			Heat of the liquid.		Heat of vaporization.		Heat equivalent of internal work.		Temperature, degrees Fahrenheit.
	Millimeters of mercury.	Kilograms per square centimeter.	Pounds per square inch.	Calories per kilogram.	B.T.U. per pound.	Calories per kilogram.	B.T.U. per pound.	Calories per kilogram.	B.T.U. per pound.	
t	p	p	p	q	q	r	r	ρ	ρ	t
31	33.57	0.04564	0.6492	31.04	55.9	579.1	1042.4	545.7	982.2	87.8
32	35.53	0.04830	0.6871	32.04	57.7	578.6	1041.4	545.1	981.0	89.6
33	37.59	0.05111	0.7269	33.04	59.5	578.0	1040.4	544.4	979.9	91.4
34	39.75	0.05404	0.7687	34.03	61.3	577.4	1039.4	543.7	978.7	93.2
35	42.02	0.05713	0.8126	35.03	63.1	576.9	1038.5	543.1	977.6	95
36	44.40	0.06037	0.8586	36.03	64.9	576.4	1037.5	542.5	976.4	96.8
37	46.90	0.06376	0.9068	37.02	66.6	575.8	1036.5	541.8	975.2	98.6
38	49.51	0.06731	0.9574	38.02	68.4	575.3	1035.5	541.2	974.0	100.4
39	52.26	0.07105	1.0105	39.02	70.2	574.7	1034.5	540.5	972.8	102.2
40	55.13	0.07495	1.0661	40.02	72.0	574.2	1033.5	539.9	971.7	104
41	58.14	0.07905	1.1243	41.01	73.8	573.6	1032.5	539.2	970.5	105.8
42	61.30	0.08334	1.1854	42.01	75.6	573.1	1031.5	538.6	969.3	107.6
43	64.59	0.08782	1.2492	43.01	77.4	572.5	1030.5	537.9	968.2	109.4
44	68.05	0.09252	1.3159	44.01	79.2	571.9	1029.4	537.2	966.9	111.2
45	71.66	0.09743	1.3858	45.00	81.0	571.3	1028.4	536.5	965.7	113
46	75.43	0.10256	1.4587	46.00	82.8	570.8	1027.4	535.8	964.5	114.8
47	79.38	0.10792	1.5350	47.00	84.6	570.2	1026.4	535.1	963.3	116.6
48	83.50	0.11353	1.6147	48.00	86.4	569.6	1025.3	534.4	962.0	118.4
49	87.80	0.11937	1.6979	48.99	88.2	569.0	1024.3	533.7	960.8	120.2
50	92.30	0.12549	1.7849	49.99	90.0	568.4	1023.2	533.0	959.6	122
51	96.99	0.13187	1.8756	50.99	91.8	567.8	1022.2	532.3	958.4	123.8
52	101.88	0.13852	1.9701	51.99	93.6	567.3	1021.2	531.7	957.2	125.6
53	106.99	0.14546	2.0689	52.99	95.4	566.8	1020.2	531.1	956.0	127.4
54	112 30	0.15268	2.172	53.98	97.2	566.2	1019.1	530.4	954.7	129.2
55	117.85	0.16023	2.279	54.98	99.0	565.6	1018.1	529.7	953.5	131
56	123.61	0.16806	2.390	55.98	100.8	565.1	1017.1	529.1	952.3	132.8
57	129.63	0.17624	2.506	56.98	102.6	564.5	1016.1	528.4	951.1	134.6
58	135.89	0.18475	2.627	57.98	104.4	563.9	1015.1	527.7	949.9	136.4
59	142.41	0.19362	2.754	58.97	106.2	563.4	1014.1	527.1	948.7	138.2
60	149.19	0.20284	2.885	59.97	108.0	562.8	1013.1	526.4	947.5	140
61	156.24	0.21242	3.021	60.97	109.8	562.2	1012.0	525.7	946.3	141.8
62	163.58	0.2224	3.163	61.97	111.6	561.7	1011.0	525.1	945.1	143.6
63	171.20	0.2328	3.310	62.97	113.4	561.1	1009.9	524.4	943.8	145.4
64	179.13	0.2435	3.464	63.98	115.2	560.5	1008.9	523.7	942.6	147.2
65	187.36	0.2547	3.623	64.98	117.0	559.9	1007.8	523.0	941.3	149
66	195.92	0.2664	3.789	65.98	118.8	559.3	1006.8	522.3	940.1	150.8
67	204.80	0.2784	3.960	66.98	120.6	558.8	1005.8	521.7	938.9	152.6
68	214.02	0.2910	4.139	67.98	122.4	558.2	1004.7	521.0	937.6	154.4
69	223.58	0.3040	4.324	68.98	124.2	557.6	1003.6	520.3	936.3	156.2
70	233.53	0.3175	4.516	69.98	126.0	556.9	1002.5	519.5	935.0	158

SATURATED STEAM (Continued)

Temperature, degrees Centigrade.	Heat equivalent of external work.		Entropy of the liquid.	Entropy of vaporization.	Specific volume.		Density.		Temperature, degrees Fahrenheit.
	Calories per kilogram.	B.T.U. per pound.			Cubic meters per kilo.	Cubic feet per pound.	Kilos per cubic meter.	Pounds per cubic foot.	
t	Apu	Apu	θ	$\frac{r}{T}$	s	s	$\frac{1}{s}$	$\frac{1}{s}$	t
31	33.4	60.2	0.1077	1.9046	31.24	501	0.03201	0.001996	**87.8**
32	33.5	60.4	0.1110	1.8966	29.62	474.7	0.03376	0.002107	**89.6**
33	33.6	60.5	0.1142	1.8886	28.08	449.7	0.03561	0.002224	**91.4**
34	33.7	60.7	0.1175	1.8806	26.62	426.5	0.03757	0.002345	**93.2**
35	33.8	60.9	0.1207	1.8728	25.25	404.7	0.03960	0.002471	**95**
36	33.9	61.1	0.1239	1.8650	23.98	384.2	0.04170	0.002603	**96.8**
37	34.0	61.3	0.1272	1.8572	22.78	364.9	0.04390	0.002740	**98.6**
38	34.1	61.5	0.1304	1.8494	21.65	346.8	0.04619	0.002884	**100.4**
39	34.2	61.7	0.1336	1.8417	20.58	329.7	0.04859	0.003033	**102.2**
40	34.3	61.8	0.1368	1.8341	19.57	313.5	0.0511	0.003190	**104**
41	34.4	62.0	0.1399	1.8265	18.61	298.0	0.0537	0.003356	**105.8**
42	34.5	62.2	0.1431	1.8189	17.69	283.3	0.0565	0.003530	**107.6**
43	34.6	62.3	0.1463	1.8113	16.82	269.5	0.0595	0.003711	**109.4**
44	34.7	62.5	0.1494	1.8038	16.01	256.5	0.0625	0.003899	**111.2**
45	34.8	62.7	0.1526	1.7693	15.25	244.4	0.0656	0.004092	**113**
46	35.0	62.9	0.1557	1.7889	14.54	233.0	0.0688	0.004292	**114.8**
47	35.1	63.1	0.1588	1.7815	13.86	222.1	0.0722	0.004502	**116.6**
48	35.2	63.3	0.1619	1.7742	13.21	211.7	0.0757	0.004724	**118.4**
49	35.3	63.5	0.1650	1.7669	12.60	201.9	0.0794	0.00495	**120.2**
50	35.4	63.6	0.1682	1.7597	12.02	192.6	0.0832	0.00519	**122**
51	35.5	63.8	0.1713	1.7525	11.47	183.8	0.0872	0.00544	**123.8**
52	35.6	64.0	0.1743	1.7454	10.96	175.5	0.0912	0.00570	**125.6**
53	35.7	64.2	0.1774	1.7383	10.47	167.7	0.0955	0.00596	**127.4**
54	35.8	64.4	0.1804	1.7312	10.00	160.3	0.1000	0.00624	**129.2**
55	35.9	64.6	0.1835	1.7242	9.56	153.2	0.1046	0.00653	**131**
56	36.0	64.8	0.1865	1.7173	9.14	146.5	0.1094	0.00683	**132.8**
57	36.1	65.0	0.1895	1.7104	8.74	140.1	0.1144	0.00713	**134.6**
58	36.2	65.2	0.1925	1.7035	8.36	134.0	0.1196	0.00746	**136.4**
59	36.3	65.4	0.1955	1.6967	8.00	128.3	0.1250	0.00779	**138.2**
60	36.4	65.6	0.1986	1.6899	7.66	122.8	0.1305	0.00814	**140**
61	36.5	65.7	0.2016	1.6831	7 34	117.6	0.1362	0.00850	**141.8**
62	36.6	65.9	0.2046	1.6764	7.03	112.7	0.1422	0.00887	**143.6**
63	36.7	66.1	0.2075	1.6696	6.74	108.0	0.1484	0.00926	**145.4**
64	36.8	66.3	0.2105	1.6629	6.46	103.5	0.1548	0.00966	**147.2**
65	36.9	66.5	0.2135	1.6563	6.19	99.2	0.1615	0.01008	**149**
66	37.0	66.7	0.2164	1.6497	5.94	95.1	0.1684	0.01051	**150.8**
67	37.1	66.9	0.2194	1.6431	5.70	91.3	0.1754	0.01095	**152.6**
68	37.2	67.1	0.2223	1.6366	5.47	87.6	0.1828	0.01142	**154.4**
69	37.3	67.3	0.2253	1.6300	5.25	84.1	0.1905	0.01189	**156.2**
70	37.4	67.4	0.2282	1.6235	5.04	80.7	0.1984	0.01239	**158**

PROPERTIES OF

Temperature, degrees Centigrade.	Pressure.			Heat of the liquid.		Heat of vaporization.		Heat equivalent of internal work.		Temperature, degrees Fahrenheit.
	Millimeters of mercury.	Kilograms per square centimeter.	Pounds per square inch.	Calories per kilogram.	B.T.U. per pound.	Calories per kilogram.	B.T.U. per pound.	Calories per kilogram.	B.T.U. per pound.	
t	p	p	p	q	q	r	r	ρ	ρ	t
71	243.8	0.3315	4.715	70.98	127.8	556.4	1001.5	518.8	933.9	**159 8**
72	254.5	0.3460	4.921	71.99	129.6	555.8	1000.4	518.1	932.6	**161.6**
73	265.6	0.3611	5.136	72.99	131.4	555.2	999.4	517.4	931.4	**163.4**
74	277.1	0.3767	5.358	73.99	133.2	554.6	998.3	516.7	930.1	**165.2**
75	289.0	0.3929	5.589	74.99	135.0	554.0	997.3	516.0	928.8	**167**
76	301.3	0.4096	5.826	76.00	136.8	553.4	996.2	515.3	927.6	**168.8**
77	314.0	0.4269	6.072	77.00	138.6	552.9	995.2	514.7	926.4	**170.6**
78	327.2	0.4449	6.327	78.00	140.4	552.3	994.1	514.0	925.2	**172.4**
79	340.9	0.4635	6.592	79.01	142.2	551.7	993.0	513.3	923.9	**174.2**
80	355.1	0.4828	6.867	80.01	144.0	551.1	991.9	512.6	922.6	**176**
81	369.7	0.5026	7.150	81.02	145.8	550.5	990.8	511.9	921.3	**177.8**
82	384.9	0.5233	7.443	82.02	147.6	549.9	989.8	511.2	920.1	**179.6**
83	400.5	0.5445	7.745	83.03	149.4	549.3	988.7	510.5	918.8	**181.4**
84	416.7	0.5665	8.058	84.03	151.2	548.7	987.6	509.8	917.6	**183.2**
85	433.5	0.5894	8.383	85.04	153.1	548.1	986.5	509.1	916.3	**185**
86	450.8	0.6129	8.717	86.04	154.9	547.4	985.4	508.3	915.0	**186.8**
87	468.6	0.6371	9.062	87.05	156.7	546.8	984.3	507.6	913.7	**188.6**
88	487.1	0.6623	9.419	88.06	158.5	546.2	983.2	506.9	912.5	**190.4**
89	506.1	0.6881	9.787	89.06	160.3	545.6	982.1	506.2	911.2	**192.2**
90	525.8	0.7149	10.167	90.07	162.1	544.9	980.9	505.4	909.9	**194**
91	546.1	0.7425	10.560	91.08	163.9	544.3	979.8	504.7	908.5	**195.8**
92	567.1	0.7710	10.966	92.08	165.7	543.7	978.7	504.0	907.2	**197.6**
93	588.7	0.8004	11.384	93.09	167.5	543.1	977.6	503.3	906.0	**199.4**
94	611.0	0.8307	11.815	94.10	169.3	542.5	976.5	502.6	904.7	**201.2**
95	634.0	0.8620	12.260	95.11	171.2	541.9	975.4	501.9	903.4	**203**
96	657.7	0.8942	12.718	96.12	173.0	541.2	974.2	501.1	902.1	**204.8**
97	682.1	0.9274	13.190	97.12	174.8	540.6	973.1	500.4	900.8	**206.6**
98	707.3	0.9616	13.678	98.13	176.6	539.9	971.9	499.6	899.4	**208.4**
99	733.3	0.9970	14.180	99.14	178.5	539.3	970.8	498.9	898.2	**210.2**
100	760.0	1.0333	14.697	100.2	180.3	538.7	969.7	498.2	896.9	**212**
101	787.5	1.0707	15.229	101.2	182.1	538.1	968.5	497.5	895.5	**213.8**
102	815.9	1.1093	15.778	102.2	183.9	537.4	967.3	496.8	894.1	**215.6**
103	845.1	1.1490	16.342	103.2	185.7	536.8	966.2	496.1	892.9	**217.4**
104	875.1	1.1898	16.923	104.2	187.6	536.2	965.1	495.4	891.6	**219.2**
105	906.1	1 2319	17.522	105.2	189.4	535.6	964.0	494.7	890.3	**221**
106	937.9	1 2752	18.137	106.2	191.2	534.9	962.8	493.9	889.0	**222.8**
107	970.6	1.3196	18.769	107.2	193.0	534.2	961.6	493.1	887.6	**224.6**
108	1004.3	1.3653	19.420	108.2	194.8	533.6	960.5	492.4	886.3	**226.4**
109	1038.8	1.4123	20.089	109.3	196.7	532.9	959.3	491.6	885.0	**228.2**
110	1074.5	1.4608	20.777	110.3	198.5	532.3	958.1	490.9	883.6	**230**

SATURATED STEAM (Continued)

Temperature, degrees, Centigrade.	Heat equivalent of external work.		Entropy of the liquid.	Entropy of vaporization.	Specific volume.		Density.		Temperature, degrees Fahrenheit.
	Calories per kilogram.	B.T.U. per pound.			Cubic meters per kilo.	Cubic feet per pound.	Kilos per cubic meter.	Pounds per cubic foot.	
t	Apu	Apu	θ	$\frac{r}{T}$	s	s	$\frac{1}{s}$	$\frac{1}{s}$	t
71	37.6	67.6	0.2311	1.6171	4.838	77.5	0.2067	0.01290	**159.8**
72	37.7	67.8	0.2340	1.6107	4.647	74.4	0.2152	0.01344	**161.6**
73	37.8	68.0	0.2639	1.6044	4.466	71.5	0.2239	0.01398	**163.4**
74	37.9	68.2	0.2398	1.5981	4.294	68.8	0.2329	0.01453	**165.2**
75	38.0	68.5	0.2427	1.5918	4.130	66.2	0.2421	0.01510	**167**
76	38.1	68.6	0.2456	1.5856	3.973	63.7	0.2517	0.01570	**168.8**
77	38.2	68.8	0.2484	1.5793	3.822	61.2	0.2616	0.01634	**170.6**
78	38.3	68.9	0.2513	1.5731	3.676	58.8	0.2720	0.01700	**172.4**
79	38.4	69.1	0.2541	1.5670	3.537	56.6	0.2827	0.01767	**174.2**
80	38.5	69.3	0.2570	1.5609	3.404	54.5	0.2938	0.01835	**176**
81	38.6	69.5	0.2598	1.5548	3.277	52.5	0.3052	0.01905	**177.8**
82	38.7	69.7	0.2626	1.5487	3.156	50.6	0.3168	0.01976	**179.6**
83	38.8	69.9	0.2654	1.5426	3.040	48.71	0.3289	0.02053	**181.4**
84	38.9	70.0	0.2682	1.5366	2.929	46.92	0.3414	0.02131	**183.2**
85	39.0	70.2	0.2711	1.5307	2.824	45.23	0.3541	0.02211	**185**
86	39.1	70.4	0.2739	1.5247	2.723	43.62	0.3672	0.02293	**186.8**
87	39.2	70.6	0.2767	1.5187	2.627	42.08	0.3807	0.02376	**188.6**
88	39.3	70.7	0.2795	1.5128	2.534	40.59	0.3946	0.02463	**190.4**
89	39.4	70.9	0.2823	1.5069	2.444	39.15	0.4091	0.02554	**192.2**
90	39.5	71.0	0.2851	1.5010	2.358	37.77	0.4241	0.02648	**194**
91	39.6	71.3	0.2879	1.4952	2.275	36.45	0.4395	0.02743	**195.8**
92	39.7	71.5	0.2906	1.4894	2.197	35.19	0.4552	0.02842	**197.6**
93	39.8	71.6	0.2934	1.4836	2.122	34.00	0.4713	0.02941	**199.4**
94	39.9	71.8	0.2961	1.4779	2.050	32.86	0.4878	0.03043	**201.2**
95	40.0	72.0	0.2989	1.4723	1.980	31.75	0.505	0.03149	**203**
96	40.1	72.1	0.3016	1.4666	1.913	30.67	0.523	0.03260	**204.8**
97	40.2	72.3	0.3043	1.4609	1.849	29.63	0.541	0.03375	**206.6**
98	40.3	72.5	0.3070	1.4552	1.787	28.64	0.560	0.03492	**208.4**
99	40.4	72.6	0.3097	1.4496	1.728	27.69	0.579	0.03611	**210.2**
100	40.5	72.8	0.3125	1.4441	1.671	26.78	0.598	0.03734	**212**
101	40.6	73.0	0.3152	1.4386	1.617	25.90	0.618	0.03861	**213.8**
102	40.6	73.2	0.3179	1.4330	1.564	25.06	0.639	0.03990	**215.6**
103	40.7	73.3	0.3205	1.4275	1.514	24.25	0.661	0.04124	**217.4**
104	40.8	73.5	0.3232	1.4220	1.465	23.47	0.683	0.04261	**219.2**
105	40.9	73.7	0.3259	1.4165	1.419	22.73	0.705	0.04400	**221**
106	41.0	73.8	0.3286	1.4111	1.374	22.01	0.728	0.04543	**222.8**
107	41.1	74.0	0.3312	1.4057	1.331	21.31	0.751	0.04692	**224.6**
108	41.2	74.2	0.3339	1.4003	1.289	20.64	0.776	0.04845	**226.4**
109	41.3	74.3	0.3365	1.3949	1.248	19.99	0.801	0.0500	**228.2**
110	41.4	74.5	0.3392	1.3895	1.209	19.37	0.827	0.0516	**230**

PROPERTIES OF

Temperature, degrees Centigrade.	Pressure.			Heat of the liquid.		Heat of vaporization.		Heat equivalent of internal work.		Temperature, degrees Fahrenheit.
	Millimeters of mercury.	Kilograms per square centimeter.	Pounds per square inch.	Calories per kilogram.	B.T.U. per pound.	Calories per kilogram.	B.T.U. per pound.	Calories per kilogram.	B.T.U. per pound.	
t	p	p	p	q	q	r	r	ρ	ρ	t
111	1111.1	1.5106	21.486	111 3	200.3	531.6	956.9	490.2	882.3	**231.8**
112	1148.7	1.5617	22.214	112.3	202.1	530.9	955.7	489.4	880.9	**233.6**
113	1187.4	1.6144	22.962	113.3	203.9	530.3	954.5	488.7	879.5	**235.4**
114	1227.1	1.6684	23.729	114.3	205.8	529.6	953.3	487.9	878.2	**237.9**
115	1267.9	1.7238	24.518	115.3	207.6	528.9	952.1	487.1	876.8	**239**
116	1309.8	1.7808	25.328	116.4	209.4	528.2	950.8	486.3	875.4	**240.8**
117	1352.8	1.8393	26.160	117.4	211.2	527.5	949.5	485.5	873.9	**242.6**
118	1397.0	1.8993	27.015	118.4	213.0	526.9	948.4	484.8	872.6	**244.4**
119	1442.4	1.9611	27.893	119.4	214.9	526.2	947.2	484.0	871.3	**246.2**
120	1488.9	2.0243	28.792	120.4	216.7	525.6	946.0	483.4	870.0	**248**
121	1536.6	2.0891	29.715	121.4	218.5	524.9	944.8	482.6	868.6	**249.8**
122	1585.7	2.1556	30.664	122.5	220.4	524.2	943.5	481.8	867.1	**251.6**
123	1636.0	2.2241	31.637	123.5	222.2	523.5	942.3	481.0	865.8	**253.4**
124	1687.5	2.2943	32.64	124.5	224.1	522.8	941.0	480.2	864.3	**255.2**
125	1740.5	2.3663	33.66	125.5	225.9	522.1	939.8	479.4	863.0	**257**
126	1794.7	2.4401	34.71	126.5	227.7	521.4	938.6	478.6	861.6	**258.8**
127	1850.3	2.5156	35.78	127.5	229.5	520.7	937.3	477.8	860.2	**260.6**
128	1907.3	2.5931	36.88	128.6	231.4	520.0	936.1	477.0	858.8	**262.4**
129	1965.8	2.6726	38.01	129.6	233.3	519.3	934.8	476.3	857.4	**264.2**
130	2025.6	2.7540	39.17	130.6	235.1	518.6	933.6	475.5	856.0	**266**
131	2086.9	2.8373	40.36	131.6	236.9	517.9	932.3	474.7	854.6	**267.8**
132	2149.8	2.9227	41.57	132.6	238.7	517.3	931.1	474.0	853.2	**269.6**
133	2214.0	3.0101	42.81	133.7	240.6	516.6	929.8	473.3	851.8	**271.4**
134	2280.0	3.0999	44.09	134.7	242.4	515.9	928.5	472.5	850.4	**273.2**
135	2347.5	3.1916	45.39	135.7	244.2	515.1	927.2	471.6	848.9	**275**
136	2416.5	3.2854	46.73	136.7	246.0	514.4	925.9	470.8	847.5	**276.8**
137	2487.3	3.3816	48.10	137.7	247.9	513.7	924.6	470.1	846.1	**278.6**
138	2559.7	3.4801	49.50	138.8	249.7	513.0	923.3	469.3	844.6	**280.4**
139	2633.8	3.581	50.93	139.8	251.6	512.3	922.1	468.5	843.3	**282.2**
140	2709.5	3.684	52.39	140.8	253.4	511.5	920.7	467.6	841.8	**284**
141	2787.1	3.789	53.89	141.8	255.3	510.7	919.3	466.8	840.2	**285.8**
142	2866.4	3.897	55.43	142.8	257.1	510.1	918.1	466.1	838.9	**287.6**
143	2947.7	4.008	57.00	143.9	259.0	509.3	916.7	465.3	837.4	**289.4**
144	3030.5	4.121	58.60	144.9	260.8	508.6	915.4	464.4	835.9	**291.2**
145	3115.3	4.236	60.24	145.9	262.7	507.8	914.1	463.6	834.5	**293**
146	3202.1	4.354	61.92	146.9	264.5	507.1	912.8	462.8	833.1	**294.8**
147	3290.8	4.474	63.64	148.0	266.4	506.4	911.5	462.0	831.6	**296.6**
148	3381.3	4.597	65.39	149.0	268.2	505.6	910.1	461.2	830.1	**298.4**
149	3474.0	4.723	67.18	150.0	270.1	504.9	908.8	460.4	828.7	**300.2**
150	3568.7	4.852	69.01	151 0	271.9	504.1	907.4	459.5	827.2	**302**

SATURATED STEAM (Continued)

Temperature, degrees Centigrade.	Heat equivalent of external work.		Entropy of the liquid.	Entropy of vaporization.	Specific volume.		Density.		Temperature, degrees Fahrenheit.
	Calories per kilogram.	B.T.U. per pound.			Cubic meters per kilo.	Cubic feet per pound.	Kilos per cubic meter.	Pounds per cubic foot.	
t	Apu	Apu	θ	$\frac{r}{T}$	s	s	$\frac{1}{s}$	$\frac{1}{s}$	t
111	41.4	74.6	0.3418	1.3842	1.172	18.77	0.853	0.0533	**231.8**
112	41.5	74.8	0.3445	1.3789	1.136	18.20	0.880	0.0550	**233.6**
113	41.6	75.0	0.3471	1.3736	1.101	17.64	0.908	0.0567	**235.4**
114	41.7	75.1	0.3498	1.3683	1.068	17.10	0.936	0.0585	**237.2**
115	41.8	75.3	0.3524	1.3631	1.036	16.59	0.965	0.0603	**239**
116	41.9	75.4	0.3550	1.3579	1.005	16.09	0.995	0.0622	**240.8**
117	42.0	75.6	0.3576	1.3527	0.9746	15.61	1.026	0.0641	**242.6**
118	42.1	75.8	0.3602	1.3475	0.9460	15.16	1.057	0.0659	**244.4**
119	42.2	75.9	0.3628	1.3423	0.9183	14.72	1.089	0.0679	**246.2**
120	42.2	76.0	0.3654	1.3372	0.8914	14.28	1.122	0.0700	**248**
121	42.3	76.2	0.3680	1.3321	0.8653	13.86	1.156	0.0721	**249.8**
122	42.4	76.4	0.3705	1.3269	0.8401	13.46	1.190	0.0743	**251.6**
123	42.5	76.5	0.3731	1.3218	0.8158	13.07	1.226	0.0765	**253.4**
124	42.6	76.7	0.3756	1.3167	0.7924	12.69	1.262	0.0788	**255.2**
125	42.7	76.8	0.3782	1.3117	0.7698	12.33	1.299	0.0811	**257**
126	42.8	77.0	0.3807	1.3067	0.7479	11.98	1.337	0.0835	**258.8**
127	42.9	77.1	0.3833	1.3017	0.7267	11.64	1.376	0.0859	**260.6**
128	43.0	77.3	0.3858	1.2967	0.7063	11.32	1.416	0.0883	**262.4**
129	43.0	77.4	0.3884	1.2917	0.6867	11.00	1.456	0.0909	**264.2**
130	43.1	77.6	0.3909	1.2868	0.6677	10.70	1.498	0.0935	**266**
131	43.2	77.7	0.3934	1.2818	0.6493	10.40	1.540	0.0961	**267.8**
132	43.3	77.9	0.3959	1.2769	0.6315	10.12	1.583	0.0988	**269.6**
133	43.3	78.0	0.3985	1.2720	0.6142	9.839	1.628	0.1016	**271.4**
134	43.4	78.1	0.4010	1.2672	0.5974	9.569	1.674	0.1045	**273.2**
135	43.5	78.3	0.4035	1.2623	0.5812	9.309	1.721	0.1074	**275**
136	43.6	78.4	0.4060	1.2574	0.5656	9.060	1.768	0.1104	**276.8**
137	43.6	78.5	0.4085	1.2526	0.5506	8.820	1.816	0.1134	**278.6**
138	43.7	78.7	0.4110	1.2479	0.5361	8.587	1.865	0.1165	**280.4**
139	43.8	78.8	0.4135	1.2431	0.5219	8.360	1.916	0.1196	**282.2**
140	43.9	78.9	0.4160	1.2383	0.5081	8.140	1.968	0.1229	**284**
141	43.9	79.1	0.4185	1.2335	0.4948	7.926	2.021	0.1262	**285.8**
142	44.0	79.2	0.4209	1.2288	0.4819	7.719	2.075	0.1296	**287.6**
143	44.0	79.3	0.4234	1.2241	0.4694	7.519	2.130	0.1330	**289.4**
144	44.2	79.5	0.4259	1.2194	0.4574	7.326	2.186	0.1365	**291.2**
145	44.2	79.6	0.4283	1.2147	0.4457	7.139	2.244	0.1401	**293**
146	44.3	79.7	0.4307	1.2100	0.4343	6.957	2.303	0.1437	**294.8**
147	44.4	79.9	0.4332	1.2054	0.4232	6.780	2.363	0.1475	**296.6**
148	44.4	80.0	0.4356	1.2008	0.4125	6.609	2.424	0.1513	**298.4**
149	44.5	80.1	0.4380	1.1962	0.4022	6.443	2.486	0.1552	**300.2**
150	44.6	80.2	0.4405	1.1916	0.3921	6.282	2.550	0.1592	**302**

PROPERTIES OF

Temperature, degrees Centigrade.	Pressure.			Heat of the liquid.		Heat of vaporization.		Heat equivalent of internal work.		Temperature, degrees Fahrenheit.
	Millimeters of mercury.	Kilograms per square centimeter.	Pounds per square inch.	Calories per kilogram.	B.T.U. per pound.	Calories per kilogram.	B.T.U. per pound.	Calories per kilogram.	B.T.U. per pound.	
t	p	p	p	q	q	r	r	ρ	ρ	t
151	3665.3	4.984	70.88	152.1	273.8	503.4	906.1	458.7	825.7	**303.8**
152	3764.1	5.118	72.79	153.1	275.6	502.6	904.7	457.9	824.2	**305.6**
153	3864.9	5.255	74.74	154.1	277.4	501.9	903.3	457.1	822.7	**307.4**
154	3968	5.395	76.73	155.1	279.2	501.1	901.9	456.3	821.2	**309.2**
155	4073	5.538	78.76	156.2	281.1	500.3	900.5	455.4	819.6	**311**
156	4181	5.684	80.84	157.2	283.0	499.6	899.2	454.6	818.2	**312.8**
157	4290	5.833	82.96	158.2	284.8	498.8	897.8	453.8	816.7	**314.6**
158	4402	5.985	85.12	159.3	286.7	498.1	896.5	453.0	815.3	**316.4**
159	4517	6.141	87.33	160.3	288.5	497.3	895.1	452.1	813.7	**318.2**
160	4633	6.300	89.59	161.3	290.4	496.5	893.7	451.2	812.2	**320**
161	4752	6.462	91.89	162.3	292.2	495.7	892.3	450.4	810.7	**321.8**
162	4874	6.628	94.25	163.4	294.1	494.9	890.9	449.5	809.2	**323.6**
163	4998	6.796	96.65	164.4	295.9	494.2	889.5	448.7	807.7	**325.4**
164	5124	6.967	99.09	165.4	297.7	493.4	888.1	447.9	806.2	**327.2**
165	5253	7.142	101.58	166.5	299.6	492.6	886.7	447.0	804.7	**329**
166	5384	7.320	104.11	167.5	301.5	491.9	885.4	446.3	803.3	**330.8**
167	5518	7.502	106.71	168.5	303.3	491.1	883.9	445.4	801.7	**332.6**
168	5655	7.688	109.35	169.5	305.1	490.3	882.5	444.6	800.1	**334.4**
169	5794	7.877	112.04	170.6	307.0	489.5	881.0	443.7	798.5	**336.2**
170	5937	8.071	114.79	171.6	308.9	488.7	879.6	442.8	797.0	**338**
171	6081	8.268	117.59	172.6	310.7	487.9	878.3	441.9	795.6	**339.8**
172	6229	8.469	120.45	173.7	312.6	487.1	876.9	441.1	794.1	**341.6**
173	6379	8.673	123.36	174.7	314.5	486.3	875.4	440.2	792.5	**343.4**
174	6533	8.882	126.33	175.7	316.3	485.5	873.9	439.4	790.9	**345.2**
175	6689	9.094	129.35	176.8	318.2	484.7	872.4	438.5	789.3	**347**
176	6848	9.310	132.43	177.8	320.0	483.9	871.0	437.7	787.8	**348.8**
177	7010	9.531	135.56	178.8	321.8	483.1	869.5	436.8	786.2	**350.6**
178	7175	9.755	138.75	179 9	323.7	482.3	868.1	436.0	784.7	**352.4**
179	7343	9.983	142.00	180.9	325.6	481.4	866.6	435.0	783.1	**354.2**
180	7514	10.216	145.30	181.9	327.5	480.6	865.1	434.2	781.5	**356**
181	7688	10.453	148.67	183.0	329.3	479.8	863.6	433.3	779.9	**357.8**
182	7866	10.695	152.11	181.0	331 2	479.0	862.2	432.5	778.4	**359.6**
183	8046	10.940	155.60	185.0	333.0	478.2	860.7	431.6	776.9	**361.4**
184	8230	11.189	159.15	186 1	334.9	477 4	859.2	430.8	775.3	**363.2**
185	8417	11.444	162.77	187 1	336.8	476.6	857.7	429.9	773.7	**365**
186	8608	11.703	166.46	188.1	338 6	475.7	856.3	429.0	772.2	**366.8**
187	8802	11.967	170.21	189.2	340 5	474.8	854.7	428.0	770.5	**368.6**
188	8999	12.235	174.02	190.2	342.4	474.0	853.2	427.2	768.9	**370.4**
189	9200	12.508	177.90	191.2	344.2	473.2	851.7	426.3	767.4	**372.2**
190	9404	12.786	181.85	192.3	346.1	472.3	850.2	425.4	765.8	**374**

SATURATED STEAM (Continued)

Temperature, degrees Centigrade.	Heat equivalent of external work.		Entropy of the liquid.	Entropy of vaporization.	Specific volume.		Density.		Temperature, degrees Fahrenheit.
	Calories per kilogram.	B.T.U. per pound.			Cubic meters per kilo.	Cubic feet per pound.	Kilos per cubic meter.	Pounds per cubic foot.	
t	Apu	Apu	θ	$\frac{r}{T}$	s	s	$\frac{1}{s}$	$\frac{1}{s}$	t
151	44.6	80.4	0.4429	1.1870	0.3824	6.126	2.615	0.1632	303.8
152	44.7	80.5	0.4453	1.1824	0.3729	5.974	2.682	0.1674	305.6
153	44.8	80.6	0.4477	1.1778	0.3637	5.826	2.750	0.1716	307.4
154	44.8	80.7	0.4501	1.1733	0.3548	5.683	2.818	0.1759	309.2
155	44.9	80.9	0.4525	1.1688	0.3463	5.546	2.888	0.1803	311
156	45.0	81.0	0.4549	1.1644	0.3380	5.413	2.959	0.1847	312.8
157	45.0	81.1	0.4573	1.1599	0.3298	5.282	3.032	0.1893	314.6
158	45.1	81.2	0.4596	1.1554	0.3218	5.154	3.108	0.1940	316.4
159	45.2	81.4	0.4620	1.1509	0.3140	5.029	3.185	0.1988	318.2
160	45.3	81.5	0.4644	1.1465	0.3063	4.906	3.265	0.2038	320
161	45.3	81.6	0.4668	1.1421	0.2989	4.789	3.345	0.2088	321.8
162	45.4	81.7	0.4692	1.1377	0.2920	4.677	3.425	0.2138	323.6
163	45.5	81.8	0.4715	1.1333	0.2855	4.571	3.503	0.2188	325.4
164	45.5	81.9	0.4739	1.1289	0.2792	4.469	3.582	0.2238	327.2
165	45.6	82.0	0.4763	1.1245	0.2729	4.368	3.664	0.2289	329
166	45.6	82.1	0.4786	1.1202	0.2666	4.268	3.751	0.2343	330.8
167	45.7	82.2	0.4810	1.1159	0.2603	4.168	3.842	0.2399	332.6
168	45.7	82.4	0.4833	1.1115	0.2540	4.070	3.937	0.2457	334.4
169	45.8	82.5	0.4857	1.1072	0.2480	3.975	4.032	0.2516	336.2
170	45.9	82.6	0.4880	1.1029	0.2423	3.883	4.127	0.2575	338
171	46.0	82.7	0.4903	1.0987	0.2368	3.794	4.223	0.2636	339.8
172	46.0	82.8	0.4926	1.0944	0.2314	3.709	4.322	0.2696	341.6
173	46.1	82.9	0.4949	1.0901	0.2262	3.626	4.421	0.2758	343.4
174	46.1	83.0	0.4972	1.0859	0.2212	3.545	4.521	0.2821	345.2
175	46.2	83.1	0.4995	1.0817	0.2164	3.467	4.621	0.2884	347
176	46.2	83.2	0.5018	1.0775	0.2117	3.391	4.724	0.2949	348.8
177	46.3	83.3	0.5041	1.0733	0.2072	3.318	4.826	0.3014	350.6
178	46.3	83.4	0.5064	1.0691	0.2027	3.247	4.933	0.3080	352.4
179	46.4	83.5	0.5087	1.0649	0.1983	3.177	5.04	0.3148	354.2
180	46.4	83.6	0.5110	1.0608	0.1941	3.109	5.15	0.3217	356
181	46.5	83.7	0.5133	1.0567	0.1899	3.041	5.27	0.3288	357.8
182	46.5	83.8	0.5156	1.0525	0.1857	2.974	5.38	0.3362	359.6
183	46.6	83.8	0.5178	1.0484	0.1817	2.911	5.50	0.3435	361.4
184	46.6	83.9	0.5201	1.0443	0.1778	2.849	5.62	0.3510	363.2
185	46.7	84.0	0.5224	1.0403	0.1740	2.787	5.75	0.3588	365
186	46.7	84.1	0.5246	1.0362	0.1702	2.727	5.88	0.3667	366.8
187	46.8	84.2	0.5269	1.0321	0.1666	2.669	6.00	0.3746	368.6
188	46.8	84.3	0.5291	1.0280	0.1632	2.614	6.13	0.3826	370.4
189	46.9	84.3	0.5314	1.0240	0.1598	2.560	6.26	0.3906	372.2
190	46.9	84.4	0.5336	1.0200	0.1565	2.507	6.39	0.3989	374

PROPERTIES OF

Temperature, degrees Centigrade.	Pressure.			Heat of the liquid.		Heat of vaporization.		Heat equivalent of internal work.		Temperature, degrees Fahrenheit.
	Millimeters of mercury.	Kilograms per square centimeter.	Pounds per square inch.	Calories per kilogram.	B.T.U. per pound.	Calories per kilogram.	B.T.U. per pound.	Calories per kilogram.	B.T.U. per pound.	
t	p	p	p	q	q	r	r	ρ	ρ	t
191	9612	13.068	185.87	193.3	347.9	471.5	848.7	424.5	764.2	**375.8**
192	9823	13.355	189.96	194.4	349.8	470.6	847.1	423.6	762.5	**377.6**
193	10038	13.647	194.11	195.4	351.7	469.8	845.6	422.8	761.0	**379.4**
194	10256	13.944	198.33	196.4	353.5	468.9	844.1	421.9	759.4	**381.2**
195	10479	14.247	202.64	197.5	355.4	468.1	842.5	421.0	757.7	**383**
196	10705	14.554	207.01	198.5	357.3	467.2	841.0	420.1	756.1	**384.8**
197	10934	14.866	211.45	199.5	359.2	466.4	839.5	419.2	754.6	**386.6**
198	11168	15.184	215.96	200.6	361.1	465.6	838.0	418.4	753.0	**388.4**
199	11406	15.507	220.56	201.6	362.9	464.7	836.4	417.4	751.3	**390.2**
200	11647	15.835	225.23	202.7	364.8	463.8	834.8	416.5	749.7	**392**
201	11893	16.169	229.98	203.7	366.7	462.9	833.3	415.6	748.1	**393.8**
202	12142	16.508	234.80	204.7	368.5	462.1	831.8	414.8	746.6	**395.6**
203	12395	16.852	239.71	205.8	370.4	461.2	830.2	413.8	744.9	**397.4**
204	12653	17.202	244.69	206.8	372.3	460.3	828.6	412.9	743.3	**399.2**
205	12915	17.558	249.75	207.9	374.1	459.4	827.0	412.0	741.6	**401**
206	13181	17.921	254.89	208.9	376.0	458.6	825.4	411.1	740.0	**402.8**
207	13452	18.289	260.13	210.0	377.9	457.7	823.8	410.2	738.3	**404.6**
208	13727	18.663	265.45	211.0	379.8	456.8	822.2	409.3	736.7	**406.4**
209	14006	19.042	270.85	212.0	381.6	455.9	820.6	408.4	735.1	**408.2**
210	14290	19.428	276.34	213.1	383.5	455.0	819.1	407.5	733.6	**410**
211	14578	19.820	281.91	214.1	385.4	454.1	817.4	406.6	731.9	**411.8**
212	14871	20.218	287.57	215.2	387.3	453.2	815.8	405.7	730.2	**413.6**
213	15168	20.622	293.31	216.2	389.2	452.4	814.3	404.9	728.7	**415.4**
214	15470	21.033	299.16	217.3	391.1	451.5	812.7	404.0	727.1	**417.2**
215	15778	21.452	305.10	218.3	392.9	450.6	811.0	403.1	725.4	**419**
216	16090	21.876	311.14	219.3	394.8	449.6	809.3	402.1	723.7	**420.8**
217	16406	22.306	317.26	220.4	396.7	448.7	807.7	401.2	722.1	**422.6**
218	16728	22.743	323.48	221.4	398.5	447.8	806.1	400.3	720.5	**424.4**
219	17055	23.188	329.81	222.5	400.4	446.9	804.5	399.4	718.9	**426.2**
220	17387	23.639	336.24	223.5	402.3	446.0	802.9	398.5	717.3	**422**

SATURATED STEAM (Concluded)

Temperature, degrees Centigrade.	Heat equivalent of external work.		Entropy of the liquid.	Entropy of vaporization.	Specific volume.		Density.		Temperature, degrees Fahrenheit.
	Calories per kilogram.	B.T.U. per pound.			Cubic meters per kilo.	Cubic feet per pound.	Kilos per cubic meter.	Pounds per cubic foot.	
t	Apu	Apu	θ	$\frac{r}{T}$	s	s	$\frac{1}{s}$	$\frac{1}{s}$	t
191	47.0	84.5	0.5358	1.0160	0.1533	2.456	6.52	0.4072	**375.8**
192	47.0	84.6	0.5381	1.0120	0.1501	2.405	6.66	0.4158	**377.6**
193	47.0	84.6	0.5403	1.0080	0.1470	2.355	6.80	0.4246	**379.4**
194	47.0	84.7	0.5426	1.0040	0.1440	2.306	6.94	0.4336	**381.2**
195	47.1	84.8	0.5448	1.0000	0.1411	2.259	7.09	0.4426	**383**
196	47.1	84.9	0.5470	0.9961	0.1382	2.214	7.23	0.4516	**384.8**
197	47.2	84.9	0.5492	0.9922	0.1354	2.169	7.38	0.4610	**386.6**
198	47.2	85.0	0.5514	0.9882	0.1327	2.126	7.53	0.4704	**388.4**
199	47.3	85.1	0.5536	0.9843	0.1300	2.083	7.69	0.4801	**390.2**
200	47.3	85.1	0.5558	0.9804	0.1274	2.041	7.84	0.4900	**392**
201	47.3	85.2	0.5580	0.9765	0.1249	2.001	8.00	0.4998	**393.8**
202	47.3	85.2	0.5602	0.9727	0.1225	1.962	8.16	0.510	**395.6**
203	47.4	85.3	0.5624	0.9688	0.1201	1.923	8.33	0.520	**397.4**
204	47.4	85.3	0.5646	0.9650	0.1177	1.885	8.50	0.531	**399.2**
205	47.4	85.4	0.5668	0.9611	0.1153	1.847	8.67	0.541	**401**
206	47.5	85.4	0.5690	0.9572	0.1130	1.810	8.85	0.552	**402.8**
207	47.5	85.5	0.5712	0.9534	0.1108	1.774	9.03	0.564	**404.6**
208	47.5	85.5	0.5733	0.9496	0.1086	1.739	9.21	0.575	**406.4**
209	47.5	85.5	0.5755	0.9458	0.1065	1.705	9.39	0.587	**408.2**
210	47.5	85.5	0.5777	0.9420	0.1044	1.673	9.58	0.598	**410**
211	47.5	85.5	0.5799	0.9382	0.1024	1.640	9.77	0.610	**411.8**
212	47.5	85.6	0.5820	0.9344	0.1004	1.608	9.96	0.622	**413.6**
213	47.5	85.6	0.5842	0.9307	0.0984	1.577	10.16	0.634	**415.4**
214	47.5	85.6	0.5863	0.9269	0.0965	1.546	10.36	0.647	**417.2**
215	47.5	85.6	0.5885	0.9232	0.0947	1.516	10.56	0.660	**419**
216	47.5	85.6	0.5906	0.9195	0.0928	1.486	10.78	0.673	**420.8**
217	47.5	85.6	0.5927	0.9157	0.0910	1.458	10.99	0.686	**422.6**
218	47.5	85.6	0.5948	0.9120	0.0893	1.430	11.20	0.699	**424.4**
219	47.5	85.6	0.5969	0.9084	0.0876	1.403	11.41	0.713	**426.2**
220	47.5	85.6	0.5991	0.9047	0.0860	1.376	11.62	0.727	**428**

HIGH AND LOW TEMPERATURES OBTAINED BY VARIOUS MEANS

Absolute zero, −273° C.

Freezing-point of helium	−272° C.
Freezing-point of hydrogen	−259
Boiling-point of hydrogen	−252
Boiling-point of liquid air at atmospheric pressure	−192
Freezing-point of carbon dioxide	− 57

Industrial furnaces	+1700 to 1800°
Bunsen burner	1870
Oxy-coal gas flame	2000
Oxy-hydrogen flame	2800
Oxy-acetylene flame	3500
Electric arc (furnace)	3500

(Sun's Temperature, 5000° C.)

HYGROMETRIC AND BAROMETRIC TABLES

CONVERSION TABLE FOR BAROMETRIC READINGS

U. S. inches to cm.

Inches.	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
27.0	68.580	.606	.631	.656	.682	.707	.733	.758	.783	.809
27.1	.834	.860	.885	.910	.936	.961	.987	*.012	*.037	*.063
27.2	69.088	.114	.139	.164	.190	.215	.241	.266	.291	.317
27.3	.342	.368	.393	.418	.444	.469	.495	.520	.545	.571
27.4	.596	.622	.647	.672	.698	.723	.749	.774	.799	.825
27.5	.850	.876	.901	.926	.952	.977	*.002	*.028	*.053	*.079
27.6	70.104	.130	.155	.180	.206	.231	.257	.282	.307	.333
27.7	.358	.384	.409	.434	.460	.485	.511	.536	.561	.587
27.8	.612	.638	.663	.688	.714	.739	.765	.790	.815	.841
27.9	.866	.892	.917	.942	.968	.993	*.018	*.044	*.069	*.095
28.0	71.120	.146	.171	.196	.222	.247	.273	.298	.323	.349
28.1	.374	.400	.425	.450	.476	.501	.527	.552	.577	.603
28.2	.628	.654	.679	.704	.730	.755	.781	.806	.831	.857
28.3	.882	.908	.933	.958	.984	*.009	*.035	*.060	*.085	*.111
28.4	72.136	.162	.187	.212	.238	.263	.289	.314	.339	.365
28.5	.390	.416	.441	.466	.492	.517	.543	.568	.593	.619
28.6	.644	.670	.695	.720	.746	.771	.797	.822	.847	.873
28.7	.898	.924	.949	.974	*.000	*.025	*.051	*.076	*.101	*.127
28.8	73.152	.178	.203	.228	.254	.279	.305	.330	.355	.381
28.9	.406	.432	.457	.482	.508	.533	.559	.584	.609	.635
29.0	.660	.686	.711	.736	.762	.787	.813	.838	.863	.889
29.1	.914	.940	.965	.990	*.016	*.041	*.067	*.092	*.117	*.143
29.2	74.168	.194	.219	.244	.270	.295	.321	.346	.371	.397
29.3	.422	.448	.473	.498	.524	.549	.575	.600	.625	.651
29.4	.676	.702	.727	.752	.778	.803	.829	.854	.879	.905
29.5	.930	.956	.981	*.006	*.032	*.057	*.083	*.108	*.133	*.159
29.6	75.184	.210	.235	.260	.286	.311	.337	.362	.387	.413
29.7	.438	.464	.489	.514	.540	.565	.591	.616	.341	.667
29.8	.692	.718	.743	.768	.794	.819	.845	.870	.895	.921
29.9	.946	.972	.997	*.022	*.048	*.073	*.099	*.124	*.149	*.175
30.0	76.200	.226	.251	.277	.302	.327	.353	.378	.404	.429
30.1	.454	.480	.505	.531	.556	.581	.607	.632	.658	.683
30.2	.708	.734	.759	.785	.810	.835	.861	.886	.912	.937
30.3	.962	.988	*.013	*.039	*.064	*.089	*.115	*.140	*.166	*.191
30.4	77.216	.242	.267	.293	.318	.343	.369	.394	.420	.445
30.5	.470	.496	.521	.547	.572	.597	.623	.648	.674	.699
30.6	.724	.750	.775	.801	.826	.851	.877	.902	.928	.953
30.7	.978	*.004	*.029	*.055	*.080	*.105	*.131	*.156	*.182	*.207
30.8	78.232	.258	.283	.309	.334	.359	.385	.410	.436	.461
30.9	.486	.512	.537	.563	.588	.613	.639	.664	.690	.715

TEMPERATURE CORRECTION, BRASS SCALE

METRIC

To reduce readings of a mercurial barometer with a brass scale to 0° C subtract the appropriate quantity as found in the table.

Temp. °C.	Observed height in centimeters.								
	70 cm.	71 cm.	72 cm.	73 cm.	74 cm.	75 cm.	76 cm.	77 cm.	78 cm.
0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1	.011	.011	.012	.012	.012	.012	.012	.012	.013
2	.023	.023	.023	.024	.024	.024	.024	.025	.025
3	.034	.034	.035	.035	.036	.036	.037	.037	.038
4	.045	.046	.046	.047	.048	.048	.049	.050	.050
5	0.056	0.057	0.058	0.059	0.060	0.060	0.061	0.062	0.063
6	.068	.069	.069	.071	.072	.072	.073	.074	.075
7	.079	.080	.081	.082	.083	.085	.086	.087	.088
8	.090	.092	.093	.094	.095	.097	.098	.099	.101
9	.102	.103	.104	.106	.107	.109	.110	.112	.113
10	0.113	0.114	0.116	0.118	0.119	0.121	0.122	0.124	0.126
11	.124	.126	.128	.129	.131	.133	.135	.137	.138
12	.135	.137	.139	.141	.143	.145	.147	.149	.151
13	.147	.149	.151	.153	.155	.157	.159	.161	.164
14	.158	.160	.163	.165	.167	.169	.172	.174	.176
15	0.169	0.172	0.174	0.177	0.179	0.181	0.184	0.186	0.189
16	.181	.183	.186	.188	.191	.194	.196	.199	.201
17	.192	.195	.197	.200	.203	.206	.208	.211	.214
18	.203	.206	.209	.212	.215	.218	.221	.224	.227
19	.215	.218	.221	.224	.227	.230	.233	.236	.239
20	0.226	0.229	0.232	0.236	0.239	0.242	0.245	0.248	0.252
21	.237	.241	.244	.247	.251	.254	.258	.261	.264
22	.249	.252	.256	.259	.263	.266	.270	.273	.277
23	.260	.264	.267	.271	.275	.278	.282	.286	.290
24	.271	.275	.279	.283	.287	.291	.294	.298	.302
25	0.283	0.287	0.291	0.295	0.299	0.303	0.307	0.311	0.315
26	.294	.298	.302	.306	.311	.315	.319	.323	.327
27	.305	.310	.314	.318	.323	.327	.331	.336	.340
28	.317	.321	.326	.330	.335	.339	.344	.348	.353
29	.328	.333	.337	.342	.347	.351	.356	.361	.365
30	0.339	0.344	0.349	0.354	0.359	0.363	0.368	0.373	0.378

CONVERSION TABLE FOR PRESSURE UNITS

Correct for mercury at 0° C.

Cms. of Hg.	Grams per sq.cm.	Dynes per sq.cm. ($g = 980$).	Lbs. per sq.in.
1	13.5956	13,323.7	0.193376
2	27.1912	26,647.4	0.386752
3	40.7868	39,971.1	0.580123
4	54.3824	53,294.8	0.773504
5	67.9780	66,618.4	0.966880
6	81.5736	79,942.1	1.160256
7	95.1692	93,265.8	1.353632
8	108.7648	106,589.5	1.547008
9	122.3604	119,913.2	1.740384

TEMPERATURE CORRECTION, GLASS SCALE

METRIC

To reduce readings of a mercurial barometer with a glass scale to 0° C. subtract the appropriate quantity as found in table.

Temp. °C.	Observed height in centimeters.								
	70 cm.	71 cm.	72 cm.	73 cm.	74 cm.	75 cm.	76 cm.	77 cm.	78 cm.
0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1	.012	.012	.013	.013	.013	.013	.013	.013	.014
2	.025	.025	.025	.026	.026	.026	.026	.027	.027
3	.036	.036	.037	.037	.038	.038	.039	.039	.040
4	.048	.049	.049	.050	.051	.051	.052	.053	.053
5	0.060	0.061	0.062	0.063	0.064	0.064	0.065	0.066	0.067
6	.073	.074	.074	.076	.077	.077	.078	.079	.080
7	.085	.086	.087	.088	.089	.091	.092	.093	.094
8	.096	.098	.099	.100	.101	.103	.104	.105	.107
9	.109	.110	.111	.113	.114	.116	.117	.119	.120
10	0.121	0.122	0.124	0.126	0.127	0.129	0.130	0.132	0.134
11	.133	.135	.137	.138	.140	.142	.144	.146	.147
12	.144	.146	.148	.150	.152	.154	.156	.158	.160
13	.157	.159	.161	.163	.165	.167	.169	.171	.174
14	.169	.171	.174	.176	.178	.180	.183	.185	.187
15	0.181	0.184	0.186	0.189	0.191	0.193	0 196	0.198	0.201
16	.194	.196	.199	.201	.204	.207	.209	.212	.214
17	.205	.208	.210	.213	.216	.219	.221	.224	.227
18	.217	.220	.223	.226	.229	.232	.235	.238	.241
19	.230	.233	.236	.239	.242	.245	.248	.251	.254
20	0.242	0.245	0.248	0.252	0.255	0.258	0.261	0.264	0.268
21	.254	.258	.261	.264	.268	.271	.275	.278	.281
22	.266	.269	.273	.276	.280	.283	.287	.290	.294
23	.278	.282	.285	.289	.293	.296	.300	.304	.308
24	.290	.294	.298	.302	.306	.310	.313	.317	.321
25	0.303	0.307	0.311	0.315	0.319	0.323	0.327	0.331	0.335
26	.315	.319	.323	.327	.332	.336	.340	.344	.348
27	.326	.331	.335	.339	.344	.348	.352	.357	.361
28	.339	.343	.348	.352	.357	.361	.366	.370	.375
29	.351	.356	.360	.365	.370	.374	.379	.384	.388
30	0.363	0.368	0.373	0.378	0.383	0.387	0.392	0.397	0.402

MASS OF WATER VAPOR IN SATURATED AIR

Mass in grams per cubic meter.

(From Smithsonian Tables.)

Temp. °C.	0.0	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0
−20	0.892	0.810	0.737	0.673	0.613	0.557	0.505	0.457	0.413	0.373
−10	2.154	1.978	1.811	1.658	1.519	1.395	1.282	1.177	1.079	0.982
− 0	4.835	4.468	4.130	3.813	3.518	3.244	2.988	2.752	2.537	2.340
+ 0	4.835	5.176	5.538	5.922	6.330	6.761	7.219	7.703	8.215	8.757
10	9.330	9.935	10.574	11.249	11.961	12.712	13.505	14.339	15.218	16.144
20	17.118	18.143	19.222	20.355	21.546	22.796	24.109	25.487	26.933	28.450
30	30.039	31.704	33.449	35.275	37.187	39.187	41.279	43.465	45.751	48.139

REDUCTION OF BAROMETER READINGS TO STANDARD TEMPERATURE

BRASS SCALE, BRITISH UNITS.

The table gives the corrections for the barometer reading in inches and the temperature in degrees Fahrenheit for a brass scale graduated to be correct at 62° F. The correction is to be subtracted.

Temp. °F.	Observed height in inches.								
	27.0	27.5	28.0	28.5	29.0	29.5	30.0	30.5	31.0
32	0.009	0.009	0.009	0.009	0.009	0.009	0.010	0.010	0.010
34	.013	.014	.014	.014	.014	.015	.015	.015	.015
36	.018	.019	.019	.019	.020	.020	.020	.021	.021
38	.023	.024	.024	.025	.025	.025	.026	.026	.027
40	.028	.029	.029	.030	.030	.031	.031	.032	.032
42	.033	.034	.034	.035	.036	.036	.038	.037	.038
44	.038	.039	.039	.040	.041	.041	.042	.043	.044
46	.043	.044	.044	.045	.046	.047	.048	.048	.049
48	.048	.049	.050	.050	.051	.052	.053	.054	.055
50	.053	.054	.055	.055	.057	.058	.058	.059	.060
52	.058	.059	.060	.060	.062	.063	.064	.065	.066
54	.062	.063	.065	.066	.067	.068	.069	.071	.072
56	.067	.068	.070	.071	.072	.074	.075	.076	.077
58	.072	.073	.075	.076	.078	.079	.080	.082	.083
60	.077	.078	.080	.081	.083	.084	.086	.087	.089
62	.082	.083	.085	.086	.088	.090	.091	.093	.094
64	.087	.088	.090	.092	.093	.095	.097	.098	.100
66	.092	.093	.095	.097	.099	.100	.102	.104	.105
68	.097	.098	.100	.102	.104	.106	.107	.109	.111
70	.102	.103	.105	.107	.109	.111	.113	.115	.117
72	.107	.108	.110	.112	.114	.116	.118	.120	.122
74	.111	.113	.116	.117	.120	.122	.124	.126	.128
76	.116	.118	.121	.123	.125	.127	.129	.131	.133
78	.121	.123	.126	.128	.130	.132	.135	.137	.139
80	.126	.128	.131	.133	.135	.138	.140	.142	.145
82	.131	.133	.136	.138	.141	.143	.146	.148	.150
84	.136	.138	.141	.143	.146	.148	.151	.153	.156
86	.141	.143	.146	.148	.151	.154	.156	.159	.162
88	.146	.148	.151	.154	.156	.159	.162	.165	.167
90	.151	.153	.156	.159	.162	.165	.167	.170	.173
92	.156	.158	.161	.164	.167	.170	.173	.176	.178
94	.160	.163	.166	.170	.172	.175	.178	.181	.184
96	.165	.168	.171	.174	.178	.181	.184	.187	.190
98	.170	.173	.177	.179	.183	.186	.189	.192	.195

CORRECTION FOR CAPILLARY DEPRESSION OF MERCURY IN A GLASS TUBE

Correction to be added.

Diam. of tube.	Height of meniscus in centimeters.							
	0.04	0.06	0.08	0.10	0.12	0.14	0.16	0.18
cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.
0.4	0.083	0.122	0.154	0.198	0.237			
0.5	.047	.065	.086	.119	.145	0.180		
0.6	.027	.041	.056	.078	.098	.121	0.143	
0.7	.018	.028	.040	.053	.067	.082	.097	.113
0.8	....	.020	.029	.038	.046	.056	.065	0.077
0.9	....	0.015	0.021	0.028	0.033	0.040	0.046	0.052
1.0	....	.....	.015	.020	.025	.029	.033	.037
1.1	....	.....	.010	.014	.018	.021	.024	.027
1.2	....	.....	.007	.010	.013	.015	.018	.019
1.3	....	.....	.004	.007	.010	.012	.013	.014

REDUCTION OF BAROMETER TO SEA LEVEL

Metric Units

Correction to be subtracted given in millimeters

(From Smithsonian Physical Tables)

Height above sea level in meters	Observed Height of Barometer in Millimeters						
	500	550	600	650	700	750	800
100	.....	.....	.....	.....	.02	.02	.02
200	.....	.....	.....	.....	.04	.05	.05
300	.....	.....	.....	.....	.07	.07	.07
400	.....	.....	.....	.....	.09	.10	.10
500	.....	.....	.....	.....	.11	.12	.13
600	.....	.....	.....	.12	.13	.14	
700	.....	.....	.....	.14	.15	.16	
800	.....	.....	.....	.16	.18	.19	
900	.....	.....	.....	.18	.20	.22	
1000	.....	.18	.19	.20	.22	.24	
1100	.....	.19	.21	.22	.24		
1200	.....	.21	.23	.24	.26		
1300	.....	.22	.24	.26	.29		
1400	.....	.24	.26	.28	.31		
1500	.24	.26	.28	.30	.33		
1600	.25	.28	.30	.32			
1700	.27	.30	.32	.34			
1800	.28	.31	.34	.36			
1900	.30	.33	.36	.39			
2000	.31	.34	.38	.41			
2100	.33	.36	.40				
2200	.35	.38	.41				
2300	.36	.40	.43				
2400	.38	.42	.45				
2500	.39	.43	.47				

English Units

Height above sea level in feet	Observed Height in Inches						
	18	20	22	24	26	28	30
1000	.....	.....	.....	.....	.003	.003	.003
2000	.....	.....	.....	.004	.005	.005	.006
3000	.....	.....	.007	.007	.008	.008	
4000	.....	.....	.009	.009	.010		
4500	.....	.....	.010	.010	.011		
5000	.....	.010	.011	.011	.012		
5500	.....	.011	.012	.013			
6000	.....	.011	.013	.014			
6500	.011	.012	.014	.015			
7000	.012	.013	.015	.016			
7500	.013	.014	.016	.017			
8000	.014	.015	.017				
8500	.015	.016	.018				
9000	.016	.017	.019				
9500	.016	.018	.020				

REDUCTION OF BAROMETER TO LATITUDE 45°

Metric Scale

For latitudes below 45°, subtract the correction; for latitudes greater than 45° it is to be added. Corrections in cm.

(From Smithsonian Meteorological Tables.)

Latitude.		Observed Height of Barometer in Centimeters.					
		68	70	72	74	76	78
25°	65°	0.116	0.120	0.123	0.127	0.130	0.133
26	64	.111	.115	.118	.121	.125	.128
27	63	.106	.110	.113	.116	.119	.122
28	62	.101	.104	.107	.110	.113	.116
29	61	.096	.099	.102	.104	.107	.110
30	60	0.091	0.094	0.096	0.098	0.101	0.104
31	59	.085	.087	.090	.092	.095	.097
32	58	.079	.082	.084	.086	.089	.091
33	57	.074	.076	.078	.080	.082	.084
34	56	.068	.070	.072	.074	.076	.078
35	55	0.062	0.064	0.066	0.067	0.069	0.071
36	54	.056	.058	.059	.061	.063	.064
37	53	.050	.051	.053	.054	.056	.057
38	52	.044	.045	.046	.048	.049	.050
39	51	.038	.039	.040	.041	.042	.043
40	50	0.031	0.032	0.033	0.034	0.035	0.036
41	49	.025	.026	.027	.027	.028	.029
42	48	.019	.019	.020	.021	.021	.022
43	47	.013	.013	.013	.014	.014	.014
44	46	.006	.007	.007	.007	.007	.007

English Scale

Corrections in inches.

Latitude.		Observed Height in Inches.					
		25	26	27	28	29	30
25°	65°	0.043	0.044	0.046	0.048	0.050	0.051
26	64	.041	.043	.044	.046	.048	.049
27	63	.039	.041	.042	.044	.045	.047
28	62	.037	.039	.040	.042	.043	.045
29	61	.035	.037	.038	.039	.041	.042
30	60	0.033	0.035	0.036	0.037	0.039	0.040
31	59	.031	.032	.034	.035	.036	.037
32	58	.029	.030	.032	.033	.034	.035
33	57	.027	.028	.029	.030	.031	.032
34	56	.025	.026	.027	.028	.029	.030
35	55	0.023	0.024	0.025	0.025	0.026	0.027
36	54	.021	.021	.022	.023	.024	.025
37	53	.018	.019	.020	.021	.021	.022
38	52	.016	.017	.017	.018	.019	.019
39	51	.014	.014	.015	.015	.016	.017
40	50	0.012	0.012	0.012	0.013	0.013	0.014
41	49	.009	.010	.010	.010	.011	.011
42	48	.007	.007	.008	.008	.008	.008
43	47	.005	.005	.005	.005	.005	.006
44	46	.002	.002	.003	.003	.003	.003

RELATIVE HUMIDITY—DEW-POINT

The table gives the relative humidity of the air for temperature t and dew-point d.

(From Smithsonian Meteorological Tables.)

Depression of dew-point $t-d$ ° C.	Dew-point (d).				
	−10	0	+10	+20	+30
0.0	100%	100%	100%	100%	100%
0.2	98	99	99	99	99
0.4	97	97	97	98	98
0.6	95	96	96	96	97
0.8	94	94	95	95	96
1.0	92	93	94	94	94
1.2	91	92	92	93	93
1.4	90	90	91	92	92
1.6	88	89	90	91	91
1.8	87	88	89	90	90
2.0	86	87	88	88	89
2.2	84	85	86	87	88
2.4	83	84	85	86	87
2.6	82	83	84	85	86
2.8	80	82	83	84	85
3.0	79	81	82	83	84
3.2	78	80	81	82	83
3.4	77	79	80	81	82
3.6	76	77	79	80	82
3.8	75	76	78	79	81
4.0	73	75	77	78	80
4.2	72	74	76	77	79
4.4	71	73	75	77	78
4.6	70	72	74	76	77
4.8	69	71	73	75	76
5.0	68	70	72	74	75
5.2	67	69	71	73	75
5.4	66	68	70	72	74
5.6	65	67	69	71	73
5.8	64	66	69	70	72
6.0	63	66	68	70	71
6.2	62	65	67	69	71
6.4	61	64	66	68	70
6.6	60	63	65	67	69
6.8	60	62	64	66	68
7.0	59	61	63	66	68
7.2	58	60	63	65	67
7.4	57	60	62	64	66
7.6	56	59	61	63	65
7.8	55	58	60	63	65

RELATIVE HUMIDITY—DEW-POINT (Continued)

Depression of dew-point $t-d$ °C.	Dew-point (d).				
	−10	0	+10	+20	+30
8.0	54	57	60	62	64
8.2	54	56	59	61	63
8.4	53	56	58	60	63
8.6	52	55	57	60	62
8.8	51	54	57	59	61
9.0	51	53	56	58	61
9.2	50	53	55	58	60
9.4	49	52	55	57	59
9.6	48	51	54	56	59
9.8	48	51	53	56	58
10.0	47	50	53	55	57
10.5	45	48	51	54	
11.0	44	47	49	52	
11.5	42	45	48	51	
12.0	41	44	47	49	
12.5	39	42	45	48	
13.0	38	41	44	46	
13.5	37	40	43	45	
14.0	35	38	41	44	
14.5	34	37	40	43	
15.0	33	36	39	42	
15.5	32	35	38	40	
16.0	31	34	37	39	
16.5	30	33	36	38	
17.0	29	32	35	37	
17.5	28	31	34	36	
18.0	27	30	33	35	
18.5	26	29	32	34	
19.0	25	28	31	33	
19.5	24	27	30	33	
20.0	24	26	29	32	
21.0	22	25	27		
22.0	21	23	26		
23.0	19	22	24		
24.0	18	21	23		
25.0	17	19	22		
26.0	16	18	21		
27.0	15	17	20		
28.0	14	16	19		
29.0	13	15	18		
30.0	12	14	17		

REDUCTION OF PSYCHROMETRIC OBSERVATION

For the reduction of observations with the wet and dry bulb thermometer, Assuming the relative velocity of the air to the thermometer bulbs is at least three meters per second; if t is the temperature of the air as indicated by the dry bulb, t_w, the temperature of the wet bulb, B, the barometric pressure, and E_w, the vapor tension of water corresponding to t_w, then the actual vapor tension is

$$E = E_w - 0.00066B(t - t_w)[1 + 0.00115(t - t_w)].$$

The value of the term

$$0.00066B(t - t_w)[1 + 0.00115(t - t_w)]$$

is given in the following table.

(From Miller's Laboratory Physics. Ginn & Co., publishers, by permission.)

$t - t_w$	Barometric Pressure B in Centimeters							
	70.0	71.0	72.0	73.0	74.0	75.0	76.0	77.0
°	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.
1	0.047	0.048	0.048	0.049	0.050	0.050	0.051	0.052
2	.093	.094	.096	.097	.098	.100	.101	.103
3	.139	.141	.143	.145	.147	.149	.152	.154
4	.186	.189	.191	.194	.197	.199	.202	.204
5	0.232	0.236	0.239	0.243	0.246	0.249	0.252	0.256
6	.279	.283	.287	.291	.295	.299	.303	.307
7	.326	.331	.336	.340	.345	.350	.354	.359
8	.373	.379	.384	.389	.395	.400	.405	.411
9	.421	.427	.432	.438	.444	.450	.456	.462
10	0.468	0.474	0.481	0.488	0.494	0.501	0.508	0.515
11	.515	.522	.530	.537	.544	.551	.559	.566
12	.562	.570	.578	.586	.594	.602	.611	.619
13	.610	.618	.627	.636	.645	.653	.662	.671
14	.658	.667	.676	.686	.695	.705	.714	.723
15	0.706	0.716	0.726	0.736	0.746	0.756	0.766	0.776
16	.754	.764	.775	.786	.796	.807	.818	.829
17	.802	.813	.824	.836	.847	.859	.870	.881
18	.850	.862	.874	.886	.898	.910	.922	.933
19	.898	.911	.923	.936	.949	.962	.975	.988
20	0.946	0.960	0.973	0.987	1.000	1.014	1.027	1.041

RELATIVE HUMIDITY

Approximate Relative Humidity from Wet and Dry Thermometer Reading

This table gives the relative humidity direct from the difference between the reading of the dry (t° C.) and the wet (t_1° C.) thermometer. It is computed for a barometer reading of 76 cm. The wet thermometer should be ventilated about 3 meters per second. From Smithsonian Tables

1°	Depression of wet-bulb thermometer, $t° - t_1°$																
	0.2°	0.4°	0.6°	0.8°	1.0°	1.2°	1.4°	1.6°	1.8°	2.0°	2.5°	3.0°	3.5°	4.0°	4.5°	5.0°	5.5°
−15	90	91	72	62	53	44	35	25	16	7	..	..	..	..	..	.	..
−12	92	85	77	69	62	54	47	39	32	25	7	..	..	..	..	..	..
−9	94	88	81	75	70	62	56	50	44	39	23	9	..	..	..	..	..
−6	95	89	85	80	74	69	54	59	54	49	36	25	13	2	..	..	..
−3	96	91	87	82	78	74	69	66	61	57	46	36	26	17	7	..	..
0	96	92	89	85	81	78	74	71	67	64	55	46	38	29	21	13	6
+3	97	94	91	87	84	81	78	75	72	69	62	54	46	40	32	25	18
	0.5°	1.0°	1.5°	2.0°	2.5°	3.0°	3.5°	4.0°	4.5°	5.0°	6.0°	7.0°	8.0°	9.0°	10°	11°	12°
+3	92	84	76	69	62	54	46	40	32	25	12	..	..	..	..	..	..
+6	94	87	80	73	66	60	54	47	41	35	23	11	..	..	..	..	..
+9	94	88	82	76	70	65	59	53	48	42	32	22	12	3	..	..	..
+12	94	89	84	78	73	68	63	58	53	48	38	30	21	12	4	..	..
+15	95	90	85	80	76	71	66	62	58	53	44	36	28	20	13	4	..
+18	95	90	86	82	78	73	69	65	61	57	49	42	35	27	20	13	6
+21	96	91	87	83	79	75	71	67	64	60	53	46	39	32	26	19	13
+24	96	92	88	85	81	77	74	70	60	63	56	49	43	37	31	26	21
+27	96	93	90	86	82	79	76	72	68	65	59	53	47	41	36	31	26
+30	96	93	90	86	82	79	76	73	70	67	61	55	50	44	39	35	30
+33	96	93	90	86	83	80	77	74	71	68	63	57	52	47	42	37	33
+36	97	93	90	87	84	81	78	75	72	70	64	57	54	50	45	41	36
+39	97	94	91	88	85	82	79	76	74	71	66	61	56	52	47	43	39

CONSTANT HUMIDITY

The following table shows the % humidity and the aqueous tension at the given temperature within a closed space when in contact with a saturated aqueous solution of the given solid phase.

Solid phase	t°C.	% humidity	Aq. tension
$H_3PO_4.\frac{1}{2}H_2O$	24	9	1.99
$ZnCl_2.1\frac{1}{2}H_2O$*	20	10	1.74
$KC_2H_3O_2$	168	13	738
$LiCl.H_2O$	20	15	2.60
$KC_2H_3O_2$	20	20	3.47
KF	100	22.9	174
NaBr	100	22.9	174
NaCl, KNO_3 and $NaNC_3$	16.39	30.49	4.23
$CaCl_2.6H_2O$	24.5	31	7.08
$CaCl_2.6H_2O$	20	32.3	5.61
$CaCl_2.6H_2O$	18.5	35	5.54
CrO_3	20	35	6.08
$CaCl_2.6H_2O$	10	38	3.47
$CaCl_2.6H_2O$	5	39.8	2.59
$Zn(NO_3)_2.6H_2O$	20	42	7.29
$K_2CO_3.2H_2O$	24.5	43	9.82
$K_2CO_3.2H_2O$	18.5	44	6.96
KNO_2	20	45	7.81
KCNS	20	47	8.16
NaI	100	50.4	383
$Ca(NO_3)_2.4H_2O$	24.5	51	11.6
$NaHSO_4.H_2O$	20	52	9.03
$Na_2Cr_2O_7.2H_2O$	20	52	9.03
$Mg(NO_3)_2.6H_2O$	24.5	52	11.9
$NaClO_3$	100	54	410
$Ca(NO_3)_2.4H_2O$	18.5	56	8.86
$Mg(NO_3)_2.6H_2O$	18.5	56	8.86
KI	100	56.2	427
$NaBr.2H_2O$	20	58	10.1
$Mg(C_2H_3O_2)_2.4H_2O$	20	65	11.3
$NaNO_2$	20	66	11.5
NH_4Cl and KNO_3	30	68.6	21.6
KBr	100	69.2	526
NH_4Cl and KNO_3	25	71.2	16.7
NH_4Cl and KNO_3	20	72.6	12.6
$NaClO_3$	20	75	13.0
$(NH_4)_2SO_4$	108.	75	754
$NaC_2H_3O_2.3H_2O$	20	76	13.2
$H_2C_2O_4.2H_2O$	20	76	13.2
$Na_2S_2O_3.5H_2O$	20	78	13.5
NH_4Cl	20	79.2	13.7

* Unstable form.

CONSTANT HUMIDITY (Continued)

Solid phase	t°C.	% humidity	Aq. tension
NH_4Cl	25	79.3	18.7
NH_4Cl	30	79.5	25.1
$(NH_4)_2SO_4$	20	81	14.1
$(NH_4)_2SO_4$	25	81.1	19.1
$(NH_4)_2SO_4$	30	81.1	25.6
KBr	20	84	14.6
Tl_2SO_4	104.7	84.8	768
$KHSO_4$	20	86	14.9
$Na_2CO_3.10H_2O$	24.5	87	20.9
$BaCl_2.2H_2O$	24.5	88	20.1
K_2CrO_4	20	88	15.3
$Pb(NO_3)_2$	103.5	88.4	760
$ZnSO_4.7H_2O$	20	90	15.6
$Na_2CO_3.10H_2O$	18.5	92	14.6
$NaBrO_3$	20	92	16.0
K_2HPO_4	20	92	16.0
$NH_4H_2PO_4$	30	92.9	29.3
$NH_4H_2PO_4$	25	93	21.9
$Na_2SO_4.10H_2O$	20	93	16.1
$NH_4H_2PO_4$	20	93.1	16.2
$ZnSO_4.7H_2O$	5	94.7	6.10
$Na_2SO_3.7H_2O$	20	95	4.34
$Na_2HPO_4.12H_2O$	20	95	4.34
NaF	100	96.6	734
$Pb(NO_3)_2$	20	98	17.0
$CaSO_4.5H_2O$	20	98	17.0
$TlNO_3$	100.3	98.7	759
$TlCl$	100.1	99.7	761

SOUND

VELOCITY OF SOUND

Solids

Approximate values.
(From Smithsonian Tables.)

Substance.	Temp. ° C.	Veloc., meters per sec.	Veloc., feet per sec.	Observer.
Metals:				
Aluminum	....	5104	16740	Masson
Brass	....	3500	11480	Various
Cadmium	....	2307	7570	Masson
Cobalt	....	4724	15500	Masson
Copper	20	3560	11670	Wertheim
Copper	100	3290	10800	Wertheim
Copper	200	2950	9690	Wertheim
Gold, soft	20	1743	5717	Wertheim
Gold, hard	....	2100	6890	Various
Iron and soft steel	....	5000	16410	Various
Iron	20	5130	16820	Wertheim
Iron	100	5300	17390	Wertheim
Iron	200	4720	15480	Wertheim
Iron cast steel	20	4990	16360	Wertheim
Iron cast steel	200	4790	15710	Wertheim
Lead	20	1227	4026	Wertheim
Magnesium	....	4602	15100	Melde
Nickel	....	4973	16320	Masson
Palladium	....	3150	10340	Various
Platinum	20	2690	8815	Wertheim
Platinum	100	2570	8437	Wertheim
Platinum	200	2460	8079	Wertheim
Silver	20	2610	8553	Wertheim
Silver	100	2640	8658	Wertheim
Tin	....	2500	8200	Various
Zinc	....	3700	12140	Various
Various:				
Brick	....	3652	11980	Chladni
Clay rock	....	3480	11420	Gray and Milne
Cork	....	500	1640	Stefan
Granite	....	3950	12960	Gray and Milne
Marble	....	3810	12500	Gray and Milne
Paraffin	15	1304	4280	Warburg
Slate	....	4510	14800	Gray and Milne
Tallow	16	390	1280	Warburg
Glass, from	....	5000	16410	Various
Glass, to	....	6000	19690	Various
Ivory	....	3013	9886	Ciccone & Campanile
Vulcanized rubber	0	54	177	Exner
Wax	17	880	2890	Stefan
Woods:				
Ash, along the fiber	....	4670	15310	Wertheim
Ash, across the rings	....	1390	4570	Wertheim
Ash, along the rings	....	1260	4140	Wertheim
Beech, along the fiber	....	3340	10960	Wertheim
Elm, along the fiber	....	4120	13516	Wertheim
Fir, along the fiber	....	4640	15220	Wertheim
Maple, along the fiber	....	4110	13470	Wertheim
Oak, along the fiber	....	3850	12620	Wertheim
Pine, along the fiber	....	3320	10900	Wertheim
Poplar, along the fiber	....	4280	14050	Wertheim
Sycamore, along fiber	....	4460	14640	Wertheim

VELOCITY OF SOUND (Continued)

LIQUIDS AND GASES

(From Smithsonian Tables.)

Substance.	Temp. ° C.	Veloc., meters per sec.	Veloc., feet per sec.	Observer.
Liquids:				
Alcohol, 95%	12.5	1241.	4072.	Dorsing, 1908
Alcohol	20.5	1213.	3890.	Dorsing, 1908
Ammonia, conc.	16.	1663.	5456.	Dorsing, 1908
Benzine	17.	1166.	3826.	Dorsing, 1908
Carbon bisulphide	15.	1161.	3809.	Dorsing, 1908
Chloroform	15.	983.	3225.	Dorsing, 1908
Ether	15.	1032.	3386.	Dorsing, 1908
NaCl, 10% sol	15.	1470.	4823.	Dorsing, 1908
NaCl, 15% sol	15.	1530.	5020.	Dorsing, 1908
NaCl, 20% sol	15.	1650.	5414.	Dorsing, 1908
Turpentine oil	15.	1326.	4351.	Dorsing, 1908
Water, air-free	13.	1441.	4728.	Dorsing, 1908
Water, air-free	19.	1461.	4794.	Dorsing, 1908
Water, air-free	31.	1505.	4938.	Dorsing, 1908
Water, Lake Geneva	9.	1435.	4708.	Colladon-Sturm
Water, Seine River	15.	1437.	4714.	Wertheim
Water, Seine River	30.	1528.	5013.	Wertheim
Water, Seine River	60.	1724.	5657.	Wertheim
Gases:				
Air, dry, CO_2-free	0.	331.78	1088.5	Rowland
Air, dry	0.	331.36	1087.1	Violle, 1900
Air, dry, CO_2-free	0.	331.92	1089.0	Thiesen, 1908
Air 1 atmosphere	0.	331.7	1088.	Mean
Air 25 atmospheres	0.	332.0	1089.	Mean (Witkowski)
Air 50 atmospheres	0.	334.7	1098.	Mean (Witkowski)
Air 100 atmospheres	0.	350.6	1150.	Mean (Witkowski)
Air	20.	344.	1129.	
Air	100.	386.	1266.	Stevens
Air	500.	553.	1814.	Stevens
Air	1000.	700.	2297.	Stevens
Ammonia	0.	415.	1361.	Masson
Carbon monoxide	0.	337.1	1106.	Wullner
Carbon dioxide	0.	258.0	846.	Bückendahl, 1906
Carbon disulphide	0.	189.	606.	Masson
Chlorine	0.	205.3	674.	Strecker
Ethylene	0.	314.	1030.	Dulong
Hydrogen	0.	1269.5	4165.	Dulong
Illuminating gas	0.	490.4	1609.	Zoch
Methane	0.	432.	1417.	Masson
Nitric oxide	0.	325.	1066.	Masson
Nitrous oxide	0.	261.8	859.	Dulong
Oxygen	0.	317.2	1041.	Dulong
Vapors:				
Alcohol	0.	230.6	756.	Masson
Ether	0.	179.2	588.	Masson
Water	0.	401.	1315.	Masson
Water	100.	404.8	1328.	Treitz, 1903
Water	130.	424.4	1392.	Treitz, 1903

MUSICAL SCALES

(From Miller's Laboratory Physics, Ginn & Co., publishers, by permission)

VIBRATION FREQUENCY OF TONES IN THE MUSICAL SCALE FOR HIGHER OR LOWER OCTAVES ARE OBTAINED BY MULTIPLYING BY SOME POWER OF 2

Scientific diatonic scale. $C_2 = 256$.		Musical equal-tempered chromatic scale. $A_3 = 435$.			
C_3	**256.**	C_3	258.65	G_3	387.54
D_3	288.	$C\#_3$	274.03	$G\#_3$	410.58
E_3	320.	D_3	290.33	A_3	**435.**
F_3	341.33	$D\#_3$	307.59	$A\#_3$	460.87
G_3	384.	E_3	325.88	B_3	488.27
A_3	426.66	F_3	345.26	C_4	517.30
B_3	480.	$F\#_3$	365.79		
C_4	512.				

SOUND ABSORPTION

The following tables relating to sound absorption are taken from Bulletin No. 172, Engineering Experiment Station, University of Illinois, by Floyd R. Watson.

SOUND ABSORBING COEFFICIENTS FOR PITCH 512

Material	Coefficient per sq. ft.
Open window	1.00
Akoustolith (artificial stone)	0.36
Ambler Sound Absorbing Plaster	0.14
Balsam Wool, bare, 1 in. thick, 0.26 lb. per sq. ft.	0.44
Brick wall	0.032
Brick wall, painted	0.017
Brick, set in cement	0.025
Calacoustic Plaster	0.16
Carpet, unlined	0.15
Carpet, lined	0.20
Carpet, with ½ in. Ozite hairfelt	0.25
Carpet rugs	0.20
Acousti-Celotex, type A, unpainted	0.25
Acousti-Celotex, type B, painted or unpainted	0.47
Acousti-Celotex, type BB, painted or unpainted	0.70
Acousti-Celotex, type C, painted or unpainted	0.30
Armstrong Cork Board, 1 in. thick, 0.875 lb. per sq. ft.	0.30
Armstrong Cork Board, sprayed with cold water paint	0.30
Armstrong Cork Board, 2 in. thick, 1.6 lb. per sq. ft.	0.35
Cork tile	0.03
Curtains in heavy folds	0.40–0.75
Fibroblock, unpainted	0.42
Flaxlinum, bare, 1 in. thick	0.61
Flaxlinum, 1 in. thick, with unpainted membrane	0.61
Gimco Rock Wool, bare	0.57
Glass, (single thickness)	0.027

SOUND ABSORPTION (Continued)

Sound Absorbing Coefficients for Pitch 512

Material	Coefficient per sq. ft.
Hairfelt, bare, 1 in. thick, 0.75 lb. per sq. ft.	0.58
Linoleum	0.03
Marble	0.01
Nashkote A, ½ in. thick	0.31
Nashkote A, ¾ in. thick	0.41
Nashkote B, ½ in. thick	0.37
Plaster on wood lath	0.034
Plaster on metal lath	0.033
Plaster on tile	0.025
Sabinite Acoustical Plaster	0.21
Stage opening, depending on stage furnishings	0.25–0.40
Ventilators	0.75
Wood, plain	0.06
Wood, varnished	0.03
Acoustic Zenitherm (cork granules cemented with plaster)	0.33

Individual Objects	Relative coefficient
Adult person	4.7
Plain wood seats	0.15
Church pews, per seat	0.2–0.5
Seats, upholstered seat and back	0.75–2.00
Seat cushions per seat	1.00–2.00

Sound Absorbing Coefficients of Various Materials

Material	Coefficient			
	Pitch = 256*	512	1024	2048
Open window (theoretical value)	1.00	1.00	1.00	1.00
Open window (experimental value)	0.945	0.98	1.08	0.985
Hairfelt, bare, 1 inch thick, 0.75 lb. per sq. ft.	0.34	0.58	0.80	0.84
Acousti-Celotex, type A, (felted bagasse fibres 1 3/16 in. thick, 1.11 lb. per sq. ft., perforated with 441 small holes per sq. ft. on back of material)	0.30	0.25	0.21	0.26
Acousti-Celotex, type B, ditto, with perforations exposed on front, painted or unpainted	0.24	0.47	0.49	0.60
Acousti-Celotex, type BB, ditto, 1¼ in. thick, 1.67 lb. per sq. ft. painted or unpainted	0.36	0.70	0.76	0.76
Acousti-Celotex, type C, ⅝ in. thick, 0.48 lb. per sq. ft., completely perforated, painted or unpainted	0.12	0.30	0.48	0.55
Armstrong Cork Board, 1 in. thick, 0.875 lb. per sq. ft.	0.08	0.30	0.31	0.28
ditto, sprayed with cold water paint	0.07	0.30	0.28	0.29
ditto, 2 in. thick, 1.6 lb. per sq. ft.	0.17	0.35	0.27	0.34
Flaxlinum (felted flax fibres), bare, 1 in. thick, 1.17 lb. per sq. ft.	0.49	0.61	0.67	0.66
Flaxlinum, (ditto), with unpainted decorative membrane (0.1 lb. per sq. ft., mesh 10 to the inch) mounted ¾ in. in front of Flaxlinum	0.30	0.61	0.60	0.55
Gimco Rock Wool (silica fibres, felted between metal lath), 1¼ in. thick, 1.44 lb. per sq. ft.	0.46	0.57	0.56	0.72

* At pitch 256 the reverberation room had a resonance, so that materials capable of vibrating would have a somewhat greater coefficient than if the resonance were absent.

SOUND ABSORPTION (continued)

Sound Absorbing Coefficients for Range of Pitch

Material	Coefficient						Authority
	n = 128	256	512	1024	2048	4096	
Open window (theoretical)	1.00	1.00	1.00	1.00	1.00	1.00	
Acoustic Zenitherm (cork granules cemented into a porous stiff tile 1.14 in. thick, 2.07 lbs. per sq. ft.)	0.03	0.13	0.33	0.42	0.42	0.15	Watson, 1926
Akoustolith Tile (1 in. thick)	0.06	0.12	0.36	0.52	0.52	0.36	W. C. Sabine, 1914
Akoustolith Plaster, ½ in. thick on ¼ in. thick lime mortar	0.21	0.24	0.29	0.33	0.37	0.42	Swan, 1923
Rumford Tile, 1 in. thick.	0.09	0.18	0.29	0.34	0.34	0.30	W. C. Sabine, 1914
Ambler Sound Absorbing Plaster	0.03	0.06	0.14	0.17	0.19	0.11	Watson, 1926
Calacoustic Plaster, 1 in. thick	0.13	0.12	0.16	0.17	0.20	0.26	Knudsen, 1927
Asbestos-Akoustikos Felt (a mixture of hair felt and asbestos, bare, ½ in. thick)	0.10	0.18	0.36	0.60	0.63	0.57	Swan, 1927
ditto, ¾ in. thick	0.18	0.30	0.54	0.64	0.63	0.57	Swan, 1927
Nashkote A (Asbestos-Akoustikos felt with muslin cemented to the felt and special paint applied, ½ in. thick)	0.10	0.20	0.31	0.40	0.39	0.32	Swan, 1927
ditto, ¾ in. thick	0.19	0.28	0.41	0.43	0.39	0.32	Swan, 1927
Nashkote B (same as A except that perforated oilcloth is glued to the felt, ½ in. thick)	0.10	0.20	0.37	0.57	0.63	0.53	Swan, 1927
Balsam Wool (loosely felted quilt of wood fiber, 1 in. thick)	....	0.18	0.44	0.62	0.66	....	Watson, 1927
Balsam Wool, covered with steel tile, perforated with 64 one-sixteenth in. holes per sq. in.	....	0.19	0.47	0.64	0.66	....	Watson, 1927
Sabinite Acoustical Plaster, ½ in. thick.	....	0.166	0.214	0.29	0.34	....	P. E. Sabine, 1927

ELECTRICITY AND MAGNETISM

SPARKING POTENTIAL OR DIELECTRIC STRENGTH

Air

Potential in volts necessary to produce a spark in air at atmospheric pressure and ordinary temperatures, the potential required depends on the shape and size of the electrodes and increases with the pressure of the air.

(From Smithsonian Tables.)

Spark length, cm.	Point electrodes, steady potential.	Ball electrodes, 1 cm. diam.	
		Steady potential.	Alternating potential.
.02	.....	1530	
.04	.....	2430	
.06	.....	3240	
.08	.....	3990	3770
.10	3720	4560	4400
.2	4680	8490	7510
.3	5310	11340	10480
.4	5970	14340	13360
.5	6300	17220	16140
.6	6840	20070	18700
.8	8070	24780	23820
1.0	8670	27810	28380
2.0	10140	45480	42950
3.0	11250	46710	
4.0	12210	49100	
5.0	13050	50310	
6.0			
8.0	.....	52400	
10.0	.....	74300	

SPECIFIC INDUCTIVE CAPACITY

Solids

Atmospheric temperatures except where noted.

(From Smithsonian Tables.)

Substance.	Wave length.	Specific inductive capacity.	Observer.
Asphalt	∞	2.68	v. Pirani, 1903
Caoutchouc	∞	2.22	Gordon, 1879
Calcspar:			
⊥ to axis	∞	8.49	Fallinger, 1902
‖ to axis	∞	7.56	Fallinger, 1902
Diamond	∞	16.5	v. Pirani, 1903
Ebonite	∞	2.72	Winklemann, 1889
Glass flint, extra heavy	∞	9.90	Hopkinson, 1891
hard crown	∞	6.96	Hopkinson, 1891
lead (Powell)	∞	5.4–8.0	Gray-Dobbie, 1898
Jena, barium	∞	7.8–8.5	Löwe, 1898
Gutta percha	.....	3.3–4.9	(submarine-data)
Ice −5° C	1200	2.85	Thwing, 1894
−18°	5000	3.16	Abegg, 1897
−190°	75	1.76–1.88	Behn-Kiebitz, 1904
Iodine, cryst	75	4.00	Schmidt, 1903
Marble, Carrara	75	8.3	Schmidt, 1903
Mica	∞	5.66–5.97	Elsas, 1891
Mica, Canadian amber	∞	3.0	E. Wilson
Paraffin	∞	2.10	Zietkowski, 1900
Phosphorus, yellow	75	3.60	Schmidt, 1903
Porcelain, hard (Royal Berlin)	∞	5.73	Starke, 1897
Quartz:			
⊥ to axis	∞	4.69	Fallinger, 1902
‖ to axis	∞	5.06	Fallinger, 1902
Selenium	∞	6.13	Vonwiller-Mason, 1907
Shellac	∞	3.10	Winkelmann, 1889
Sulphur, amorphous	∞	3.98	v. Pirani, 1903
Sulphur, cast, fresh	∞	4.22	v. Pirani, 1903
Wood, dry:			
red beech	∞	4.83–2.51	
red beech	∞	7.73–3.63	
oak	∞	4.22–2.46	
oak	∞	6.84–3.64	

SPECIFIC INDUCTIVE CAPACITY (Continued)

GASES

The specific inductive capacity of a vacuum is taken as unity. Wave-lengths of the measuring current greater than 10,000 cm.

(Dielectric constant.)

Gas.	Temp. ° C.	Pressure in atmospheres.	Specific inductive capacity.	Observer.
Air	0	1	1.000590	Boltzmann, 1875
Air	19	20	1.0108	Tangl, 1907
Air	....	40	1.0218	Tangl, 1907
Air	....	60	1.0330	Tangl, 1907
Air	....	80	1.0439	Tangl, 1907
Air	....	100	1.0548	Tangl, 1907
Ammonia	20	1	1.00718	Bädeker, 1901
Carbon bisulphide	0	1	1.00290	Klemenčič
Carbon bisulphide	100	1	1.00239	Bädeker
Carbon dioxide	0	1	1.000985	Klemenčič
Carbon dioxide	15	10	1.008	Linde, 1895
Carbon dioxide	....	20	1.020	Linde, 1895
Carbon dioxide	....	40	1.060	Linde, 1895
Carbon monoxide	0	1	1.000690	Boltzmann
Ethylene	0	1	1.00131	Boltzmann
Hydrochloric acid	100	1	1.00258	Bädeker
Hydrogen	0	1	1.000264	Boltzmann
Methane	0	1	1.000944	Boltzmann
Nitrous oxide (N_2O)	0	1	1.00116	Boltzmann
Nitrous oxide (N_2O)	15	10	1.010	Linde, 1895
Nitrous oxide (N_2O)	....	20	1.025	Linde, 1895
Nitrous oxide (N_2O)	....	40	1.070	Linde, 1895
Sulphur dioxide	0	1	1.00993	Bädeker
Sulphur dioxide	0	1	1.00905	Klemenčič
Water vapor	145	4	1.00705	Bädeker

LIQUIDS

Where the wave-length is not specified it is greater than 10,000 cm.

Liquid.	Temp. ° C.	Wave length.	Specific inductive capacity.	Observer.
Acetic acid	18	∞	9.7	Francke, 1893
Acetone	0	∞	26.6	Abegg, 1897
Air	−191	∞	1.43	v. Pirani, 1903
Alcohol:				
amyl	0	∞	17.4	Abegg-Seitz, 1899
amyl	+20	∞	16.0	Abegg-Seitz, 1899
ethyl	frozen	∞	2.7	Abegg-Seitz, 1899
ethyl	−120	∞	54.6	Abegg-Seitz, 1899

SPECIFIC INDUCTIVE CAPACITY (Continued)

Liquids (Continued)

Liquid.	Temp. ° C.	Wave length.	Specific inductive capacity.	Observer.
Alcohol:				
ethyl	−80	∞	44.3	Abegg-Seitz, 1899
ethyl	−40	∞	35.3	Abegg-Seitz, 1899
ethyl	0	∞	28.4	Abegg-Seitz, 1899
ethyl	+20	∞	25.8	Abegg-Seitz, 1899
ethyl	17	200	24.4	Drude, 1896
ethyl	17	75	23.0	Drude, 1896
ethyl	17	53	20.6	Marx, 1898
ethyl	17	4	8.8	Marx, 1898
ethyl	17	0.4	5.0	Lampa, 1896
methyl	0	∞	35.0	Abegg-Seitz, 1899
methyl	+20	∞	31.2	Abegg-Seitz, 1899
propyl	0	∞	24.8	Abegg-Seitz, 1899
propyl	+20	∞	22.2	Abegg-Seitz, 1899
Ammonia	−34	75	21–23	Goodwin-Thompson, 1899
Amyl acetate	19	∞	4.81	Löwe, 1898
Anilin	18	∞	7.316	Turner, 1900
Benzol (Benzene)	18	∞	2.288	Turner, 1900
Bromine	23	84	3.18	Schlundt
Carbon bisulphide	20	∞	2.626	Tangl, 1903
Carbon dioxide	−5	∞	1.60	Linde, 1895
Chlorine	−60	∞	2.15	Linde, 1895
Chloroform	18	∞	5.2	Turner, 1900
Ethyl ether	0	∞	4.68	Abegg, 1897
Ethyl ether	20	∞	4.30	Tangl, 1903
Glycerine	15	1200	56.2	Thwing, 1894
Hydrogen peroxide 46% in H_2O	18	75	84.7	Calvert, 1900
Hydrogen sulphide	10	∞	5.93	Eversheim, 1904
Nitrous oxide, N_2O	−88	∞	1.93	Hasenhörl, 1900
Oils:				
castor	11	∞	4.67	Arons-Rubens, 1892
cottonseed	14	∞	3.10	Salvioni, 1888
linseed	13	∞	3.35	Salvioni, 1888
olive	20	∞	3.11	Heinke, 1896
petroleum	....	2000	2.13	Marx
sperm	20	∞	3.17	Hopkinson, 1881
turpentine	20	∞	2.23	Hopkinson, 1881
Oxygen	−182	∞	1.49	Fleming-Dewar, 1896
Phenol	48	73	9.68	Drude, 1896
Sulphur dioxide	20	∞	14.0	Eversheim, 1904
Water	18	∞	81.07	Turner, 1900

SPARKING POTENTIAL OR DIELECTRIC STRENGTH

Various Insulators.

Potential to puncture in kilovolts per centimeter. 1 kilovolt = 1000 volts

Substance.	Thickness used mm.	Kilovolts per cm.
Air, liquid	.....	40–90
Ebonite	.....	300–1100
Fiber	.....	20
Glass	.....	300–1500
Guttapercha	.....	80–200
Kerosene	1.0	164
Linen, varnished	.....	100–200
Mica	0.1	1500–2200
Mica	1.0	300–700
Oils:		
castor	0.2	190
castor	1.0	130
cottonseed	.....	70
lard	0.2	140
lard	1.0	40
linseed, raw	0.2	185
raw	1.0	90
boiled	0.2	190
boiled	1.0	80
lubricating	.....	50
olive	0.2	170
olive	1.0	75
paraffin	0.2	215
paraffin	1.0	160
sperm, mineral	0.2	180
mineral	1.0	85
natural	0.2	195
natural	1.0	90
turpentine	0.2	160
turpentine	1.0	110
Papers:		
beeswaxed	.....	770
blotting	.....	150
Manilla	.....	25
paraffined	.....	500
varnished	.....	100–250
Paraffin:		
melted	.....	75
solid, melt. point 43°	.....	350
solid, melt. point 70°	.....	450
Rubber	.....	160–500
Vaseline	.....	90–130
Xylol	0.2	140
Xylol	1.0	80

ELECTROMOTIVE FORCE AND COMPOSITION OF VOLTAIC CELLS

STANDARD CELLS
(From Smithsonian Tables.)

Name of cell.	Negative pole.	Solution.	Positive pole.	Depolarizer.	E.M.F. in volts.
Weston normal..	Cadmium amalgam...	Saturated solution of $CdSO_4$.....	Mercury..	Paste of Hg_2SO_4 and $CdSO_4$	1.0183 at 20° C.
Clark standard..	Zinc amalgam.....	Saturated solution of $ZnSO_4$.....	Mercury..	Paste of Hg_2SO_4 and $ZnSO_4$.	1.4328 at 15° C.

Temperature equations:

Clark cell: $E_t = 1.4328[1 - 0.00119(t - 15) - 0.000007(t - 15)^2]$ volt

Weston cell: $E_t = 1.0183[1 - 0.0000406(t - 20) - 0.00000095(t - 20)^2 + 0.00000001(t - 20)^3]$ volt

DOUBLE FLUID CELLS

Name of cell.	Negative pole.	Solution.	Positive pole.	Solution.	E.M.F. in volts.
Bunsen.....	Amal. zinc.....	1 part H_2SO_4 to 12 parts H_2O....	Carbon...	Fuming nitric acid.....	1.94
Bunsen.....	Amal. zinc.....	1 part H_2SO_4 to 12 parts H_2O....	Carbon...	HNO_3, density, 1.38.....	1.86
Bichromate.....	Amal. zinc.....	12 parts $K_2Cr_2O_7$ to 25 parts H_2SO_4 and 100 parts H_2O.	Carbon...	1 part H_2SO_4 to 12 parts H_2O	2.00
Bichromate.....	Amal. zinc.....	1 part H_2SO_4 to 12 parts H_2O....	Carbon...	12 parts $K_2Cr_2O_7$ to 100 parts H_2O.....	2.03
Daniell.....	Amal. zinc.....	1 part H_2SO_4 to 4 parts H_2O.....	Copper...	Saturated solution of $CuSO_4 + 5H_2O$.....	1.06
Daniell.....	Amal. zinc.....	5% solution of $ZnSO_4 + 6H_2O$....	Copper...	Saturated solution of $CuSO_4 + 5H_2O$.....	1.08
Daniell	Amal. zinc.....	1 part NaCl to 4 parts H_2O.....	Copper...	Saturated solution of $CuSO_4 + 5H_2O$.....	1.05
Grove.....	Amal. zinc.....	1 part H_2SO_4 to 12 parts H_2O....	Platinum .	Fuming nitric acid.....	1.93
Grove.....	Amal. zinc.....	Solution of $ZnSO_4$.....	Platinum .	HNO_3 density 1.33.....	1.66

DOUBLE FLUID CELLS (Continued)

Name of cell.	Negative pole.	Solution.	Positive pole.	Solution.	E.M.F. in volts.
Grove	Amal. zinc	H_2SO_4 solution, density 1.136	Platinum	HNO_3 density 1.33	1.79
Grove	Amal. zinc	H_2SO_4 solution, density 1.14	Platinum	HNO_3 density 1.19	1.66
Grove	Amal. zinc	NaCl solution	Platinum	HNO_3 density, 1.33	1.88

SINGLE FLUID CELLS

Name of cell.	Negative pole.	Solution.	Positive pole.	E.M.F.
Leclanché	Amal. zinc	Solution of sal-ammoniac	Carbon, depolarizer: manganese peroxide with powd. carbon	1.46
Edison-Lalande	Amal. zinc	Solution of caustic potash	Copper, depolarizer, CuO	0.70
Chloride of silver	Zinc	23% sol. of sal-ammoniac	Silver, depolarizer: silver chloride	1.02

STORAGE CELLS

Name of cell.	Negative pole.	Solution.	Positive pole.	E.M.F.
Lead accumulator	Lead	H_2SO_4 solution of density 1.1	PbO_2	2.2
Regnier (1)	Copper	$CuSO_4+H_2SO_4$	PbO_2	1.68 to 0.85. average, 1.3
Regnier (2)	Amal. zinc	$ZnSO_4$ solution	PbO_2 in H_2SO_4	2.36
Main	Amal. zinc	H_2SO_4, density about 1.1	PbO_2	2.50
Edison	Iron	KOH, 20% solution	A nickel oxide	1.1, mean of full discharge

CONTACT DIFFERENCE OF POTENTIAL

METALS

The values in the table give the potential in volts of the metal at the top of the column with respect to the metal named at the left.

(Tabulated from results by Pellat, 1881.)

	Antimony.	Bismuth.	Brass.	Copper.	Gold.	Iron.
Antimony	0	−.08	−.06	−.30	−.48	−.15
Bismuth	+.08	0	−.07	−.22	−.40	−.07
Brass	+.06	+.07	0	+.15	−.33	0
Copper	+.30	+.22	−.15	0	−.18	+.15
Gold	+.48	+.40	+.33	+.18	0	+.33
Iron	+.15	+.07	0	−.15	−.33	0
Lead	−.26	−.34	−.41	−.56	−.74	−.41
Nickel	+.06	−.02	−.09	−.24	−.42	−.09
Platinum	+.46	+.39	+.32	+.17	−.01	+.32
Silver	+.50	+.42	+.35	+.20	+.02	+.35
Tin	−.16	−.24	−.31	−.46	−.64	−.31
Zinc	−.41	−.49	−.56	−.71	−.89	−.56
Carbon*	.....	.....	+.41	+.37	.....	+.48
Mercury	.....	.....	.....	+.31	.....	+.50

	Lead.	Nickel.	Platinum.	Silver.	Tin.	Zinc.	Carbon.
Antimony	+.26	−.06	−.46	−.50	+.16	+.41	
Bismuth	+.34	+.02	−.39	−.42	+.24	+.49	
Brass	+.41	+.09	−.32	−.35	+.31	+.56	−.41
Copper	+.56	+.24	−.17	−.20	+.46	+.71	−.37
Gold	+.74	+.42	+.01	−.02	+.64	+.89	
Iron	+.41	+.09	−.32	−.35	+.31	+.56	−.48
Lead	0	−.32	−.73	−.76	−.10	+.15	−.85
Nickel	+.32	0	−.41	−.44	+.22	+.47	
Platinum	+.73	+.41	0	−.03	+.63	+.88	−.11
Silver	+.76	+.44	+.03	0	+.66	+.91	
Tin	+.10	−.22	−.63	−.66	0	+.25	−.79
Zinc	−.15	−.47	−.88	−.91	−.25	0	−1.10
Carbon*	+.85	.....	+.11	.....	+.79	+1.10	0
Mercury	.....	.....	+.16	.....	.....	.....	+.09

* Ayrton and Perry.

DIFFERENCE OF POTENTIAL BETWEEN METALS IN SOLUTIONS OF SALTS

The table gives the difference in potential in hundredths of a volt between zinc in a normal solution of sulphuric acid and the metal named at the head of the columns in the solution named at the side. The signs given refer to the external difference of potential.

(Magnanini.)

Strength of the solution in gramme molecules per liter.	Difference of potential in centivolts.					
	Zinc	Cadmium	Lead.	Tin.	Copper.	Silver.
0.5 Sulphuric acid	0.0	36.6	51.3	51.3	100.7	121.3
1.0 Sodium hydroxide	−32.1	19.5	31.8	0.2	80.2	95.8
1.0 Potassium hydroxide	−42.5	15.5	32.0	−1.2	77.0	104.0
0.5 Sodium sulphate	1.4	35.6	50.8	51.4	101.3	120.9
1.0 Potassium nitrate	11.8	31.9	42.6	31.1	81.2	105.7
1.0 Sodium nitrate	11.5	32.3	51.0	40.9	95.7	114.8
0.5 Potassium bichromate	72.8	61.1	78.4	68.1	123.6	132.4
0.5 Potassium sulphate	1.8	34.7	51.0	40.9	95.7	114.8
0.2 Potassium chlorate	15.−10.	39.9	53.8	57.7	105.2	120.9
1.0 Ammonium chloride	2.9	32.4	51.3	50.9	81.2	101.7
1.0 Sodium chloride	.....	31.9	51.2	50.3	80.9	101.3
1.0 Potassium chloride	.....	32.1	51.6	52.6	81.6	107.6

PROPERTIES OF METALS AS CONDUCTORS

Metal.	Resistivity microhm-centimeters 20° C.	Temp. coefficient 20° C.	Specific gravity.	Tensile strength, lbs./in.	Melting point ° C.
Advance. See *constantan*					
Aluminum	2.824	0.0039	2.70	30,000	659
Antimony	41.7	.0036	6.6	.....	630
Arsenic	33.3	.0042	5.73	.....	.....
Bismuth	120	.004	9.8	.....	271
Brass	7	.002	8.6	70,000	900
Cadmium	7.6	.0038	8.6	.....	321
Calido. See *nichrome*					
Climax	87	.0007	8.1	150,000	1250
Cobalt	9.8	.0033	8.71	.....	1480
Constantan	49	.00001	8.9	120,000	1190
Copper: annealed	1.7241	.00393	8.89	30,000	1083
hard-drawn	1.771	.00382	8.89	60,000	.....
Eureka. See *constantan*					
Excello	92	.00016	8.9	95,000	1500
Gas Carbon	5000	—.0005	.....	.....	3500
German silver, 18%Ni	33	.0004	8.4	150,000	1100
Gold	2.44	.0034	19.3	20,000	1063
Ideal. See *constantan*					
Iron, 99.98% pure	10	.005	7.8	.....	1530
Lead	22	.0039	11.4	3,000	327
Magnesium	4.6	.004	1.74	33,000	651
Manganin	44	.00001	8.4	150,000	910
Mercury	95.783	.00089	13.546	0	—38.9
Molybdenum, drawn	5.7	.004	9.0	.....	2500
Monel metal	42	.0020	8.9	160,000	1300
Nichrome	100	.0004	8.2	150,000	1500
Nickel	7.8	.006	8.9	120,000	1452
Palladium	11	.0033	12.2	39,000	1550
Phosphor bronze	7.8	.0018	8.9	25,000	750
Platinum	10	.003	21.4	50,000	1755
Silver	1.59	.0038	10.5	42,000	960
Steel, E. B. B.	10.4	.005	7.7	53,000	1510
Steel, B. B.	11.9	.004	7.7	58,000	1510
Steel, Siemens-Martin	18	.003	7.7	100,000	1510
Steel, manganese	70	.001	7.5	230,000	1260
Tantalum	15.5	.0031	16.6	.....	2850
Therlo	47	.00001	8.2	.....	.....
Tin	11.5	.0042	7.3	4,000	232
Tungsten, drawn	5.6	.0045	19	500,000	3400
Zinc	5.8	.0037	7.1	10,000	419

RESISTIVITY

Giving the resistivity ρ for metals, including alloys and carbon. Temperature coefficients of resistance are given in a succeeding table.

Material	Temp. °C.	Resistivity ohm-cm	Authority
Advance, see constantan			
Aluminum, commercial Al 99.57, Si 0.29, Fe 0.14	20	2.828×10^{-6}	Bureau of Standards
pure	−189	.64	Niccolai, 1907
	−100	1.53	"
	0	2.63	"
	+100	3.86	"
	400	8.0	"
Aluminum bronze	0	12.—13.	Various
Cu 97, Al 3	0	8.26	Pecheux, 1909
Cu 90, Al 10	0	12.6	"
Cu 6, Al 94	0	3.1	"
Antimony	20	41.7	Bureau of Standards
	−190	10.5	Eucken, Gelhoff
liquid	+860	120.	de la Rive
Argentan Cu 56, Ni 26	15	42.	Matthiessen
Arsenic	0	35.	"
Bismuth	18	119.0	Jäger, Diesselhorst
	100	160.2	" "
	−200	34.8	Various
	−100	75.6	"
	+100	156.5	Northrup, 1914
	200	214.5	"
liquid	300	128.9	"
"	500	139.9	"
"	700	150.8	"
Brass various	0	6.4—8.4	Various
hard drawn Cu 70.2, Zn 29.8	0	8.2	Siemens
annealed	0	7.0	"
Bronze Cu 88, Sn 12	20	18	
Cu 89, Sn 6, Zn 4	15	13.5	
Cadmium, drawn	18	7.54	Jäger, Diesselhorst
	100	9.82	" "
	−252.9	0.17	Euchen, Gehlhoff, 1912
	−200	1.66	" "
	−100	4.80	" "
	+300	16.50	Northrup, 1913
liquid	400	33.70	"
	500	35.12	"
	700	35.78	"
Caesium	0	19	Various
	−187	5.25	Guntz, Broniewski
liquid	27	22.2	Hackspill
	30	36.6	"
Calcium, Ca 99.57%	20	4.6	Swisher, 1917
Calido, (*See constantan*)			
Carbon	0	3500	
	500	2700	
	1000	2100	
	2000	1100	
	2500	900	

RESISTIVITY (Continued)

Material	Temp. °C.	Resistivity ohm-cm	Authority
Chromel, (*See nichrome*)			
Chromium	0	2.6×10^{-6}	Shukow
Climax,	20	87	Bureau of Standards
Cobalt, Co 99.8%	20	9.7	Reichardt, 1901
Constantan, Cu 60, Ni 40	20	49	Bureau of Standards
	−200	42.4	Niccolai
	−150	43.0	"
	−100	43.5	"
	−50	43.9	"
	0	44.1	"
	+100	44.6	"
	400	44.8	"
Copper, commercial	20	1.724	Bureau of Standards
annealed			"
hard drawn	20	1.77	
pure, annealed	20	1.692	Wolff, Dellinger 1910
	−258.6	.014	Niccolai
	−206.6	.163	"
	−150	.567	"
	−100	904	"
	+100	2.28	Northrup, 1914
	200	2.96	"
	500	5.08	"
	1000	9.42	"
liquid	1500	24.62	"
Copper-manganese			
Cu 96.5, Mn 3.5		15	Feussner, Lindeck 1895
Cu 92, Mn 8		28.4	" "
Cu 70, Mn 30	0	101	
Copper-manganese-iron			
Cu 91, Mn 7.1, Fe 1.9	0	20	Blood
Cu 70.6, Mn 23.2, Fe 6.2	0	77	"
Copper-manganese-nickel			
Cu 73, Mn 24, Ni 3	0	48	Feussner, Lindeck
Eureka	0	47	Drysdale, 1907
Excello	20	92	Bureau of Standards
Gallium	0	53	Guntz, Broniewski
German silver, Ni 18% Cu 60.16, Zn 25.37, Ni 14.03, Fe 0.3, Co and Mn trace	20	33	Bureau of Standards
	−200	27.9	Dewar, Fleming
	−100	29.3	
	+100	33.1	
Gold, pure, drawn	20	2.44	Jäger, Diesselhorst
	−252.8	.018	Niccolai
	−200	.601	"
99.9 pure	−183	.68	Dewar, Fleming
	−150	.997	Niccolai, 1907
	−100	1.400	"
	+100	2.97	Northrup, 1914

RESISTIVITY (Continued)

Material	Temp. °C.	Resistivity ohm-cm	Authority
Gold, 99.9 pure	200	3.83×10^{-6}	Northrop, 1914
	500	6.62	"
	1000	12.52	"
	1500	3.70	"
Gold-copper-silver			
Au 58.3, Cu 26.5, Ag 15.2	0	13.2	Matthiessen
Au 66.5, Cu 15.4, Ag 18.1	0	14.6	"
Au 7.4, Cu 78.3, Ag 14.3	0	3.6	"
Gold-silver			
Au 90, Ag 10	0	6.3	
Au 67, Ag 33	0	10.8	
Graphite	0	800	
	500	830	
	1000	870	
	2000	1000	
	2500	1100	
Ia — Ia			
Cu 60, Ni 40	0	50	Drysdale, 1907
Ideal, (*See constantan*)			
Illium		91.61	Knipp, Hall 1922
Indium	0	8.37	Erhardt, 1881
Invar (*See steel*)			
Iridium	−186	1.92	Broniewski, Hackspill
	0	6.10	" "
	100	8.30	" "
Iron 99.98% pure	20	10	Bureau of Standards
	−252.7	0.011	Niccolai
	−205.3	.652	Dawar, Fleming
	−200.	2.27	Niccolai
	−192.5	.844	"
	−100	5.92	"
	+100	16.61	"
	200	24.50	"
	400	43.29	"
(*See also under steel*)			
Lead	20	22.	Bureau of Standards
	−252.9	.59	Schimank, Nernst
	−203	4.42	" "
	−192.8	5.22	" "
	−103	11.8	
	+100	27.8	Northrup
	200	38	"
	319	50	"
liquid	333	95.0	"
"	400	98.3	"
"	600	107.2	"
"	800	116.2	"
cold pressed	−183	6.02	Dewar, Fleming
" "	−78	14.1	
" "	0	20.4	
" "	90.4	28.0	
	196.1	36.9	
Lithium	−187	1.34	Guntz, Broniewski
	0	8.55	" "
	99.3	12.7	" "

RESISTIVITY (Continued)

Material	Temp. °C.	Resistivity ohm-cm	Authority
Lithium liquid	230	45.2×10^{-6}	Bernini, 1905
Magnesium	20	4.6	Bureau of Standards
Zn free	−183	1.00	Dewar, Fleming
" "	−78	2.97	" "
" "	0	4.35	" "
" "	98.5	5.99	" "
pure	400	11.9	Niccolai, 1907
Manganese		5.0	Shukow
Manganese-copper			
Mn 30, Cu 70	C	100	Feussner, Lindeck
Manganin, Cu 84,	20	44	Bureau of Standards
Mn 12, Ni 4	22.5	45	Kimura, Sakamaki
	−200	37.8	Niccolai
	−100	38.5	"
	−50	38.7	"
	0	38.8	"
	100	38.9	"
	400	38.3	"
Mercury	20	95.783	Bureau of Standards
solid	−183.5	6.97	Dewar, Fleming
"	−102.9	15.04	" "
"	−50.3	12.3	" "
"	−39.2	25.5	" "
liquid	−36.1	80.6	" "
"	0	94.07	" "
"	50	98.50	Grimaldi
"	100	103.25	Vincentini, Omodei
"	200	114.27	" "
"	350	135.5	" "
"	100	103.1	Northrup
"	200	114.0	"
"	300	127.0	"
Molybdenum, drawn	20	5.7	Bureau of Standards
Monel metal	20	42	Bureau of Standards
Nichrome	20	100	Bureau of Standards
Nickel	20	7.8	Bureau of Standards
pure	−182.5	1.44	Fleming, 1900
"	−78.2	4.31	"
"	0	6.93	"
"	94.9	11.1	"
"	400	60.2	Niccolai, 1907
Nickel-copper-zinc	0	20.3	Matthiessen
Ni 12.84, Cu 30.59			
Zn 6.57 by vol.			
Nickelin	0	33	Feussner, Lindeck
Ni 18.46, Cu 61.63			
Zn 19.67, Fe 0.24			
Co 0.19, Mn 0.18			
Osmium	20	60.2	Niccolai
Palladium	20	11	Bureau of Standards
	−183	2.78	Dewar, Fleming
	−78	7.17	" "
	0	10.21	" "
	98.5	13.79	" "
Patent nickel	0	34	Feussner, Lindeck
Ni 25.1, Cu 74.41			
Fe 0.42, Zn 0.23			
Mn 0.13, Co trace			
Phosphor bronze	0	5–10	Various

RESISTIVITY (Continued)

Material	Temp. °C.	Resistivity ohm-cm	Authority
Platinoid, Cu 62, Ni 15, Zn 22	−160	32.5×10^{-6}	Lees, 1908
	18	34.4	"
Platinum	20	10	Bureau of Standards
	−203.1	2.44	Dewar, Fleming
	−97.5	6.87	" "
	0	10.96	" "
	+100	14.85	" "
	400	26	Niccolai
	−265	.10	Nernst
	−253	.15	"
	−233	.54	"
	−153	4.18	"
	−73	7.82	"
	0	11.05	"
	+100	14.1	Pirrani
	200	17.9	"
	400	25.4	"
	800	40.3	"
	1000	47.0	"
	1200	52.7	"
	1400	58.0	"
	1600	63.0	"
Platinum-iridium P 90, Ir 10	0	24	Barnes, 1888
P 80, Ir 20	0	31	"
Platinum-rhodium Pt 90, Rh 10	−200	14.49	Dewar, Fleming
	−100	18.05	" "
	0	21.14	" "
	+100	24.20	" "
Platinum-silver Pt 67, Ag 33	0	24.2	
Platinite, nickel steel Ni 46–48%	0	45	
Potassium	−200	1.72	Guntz, Broniewski
	−100	3.72	" "
	−75	4.0	Hackspill
	0	6.1	"
	+55	8.4	"
liquid	100	15.31	Northrup
Rheotan Cu 53.28, Ni 25.31 Zn 16.80, Fe 4.46 Mn 0.37	0	53	Feussner, Lindeck
Rhodium	−186	0.7	Broniewski, Hackspill
	−78.3	3.09	" "
	0	4.69	" "
	+100	6.60	" "
Rose metal Bi 49, Pb 28, Sm 23	0	64	
Rubidium	−190	2.5	Hackspill
	0	11.6	
	+35	13.4	
liquid	40	19.6	
Silicium (silicon)	20	58.	
Silicium bronze	0	2.4	
Silver 99.98% electrolytic	18	1.629	Jäger, Diesselhorst
"	−183	0.390	Dewar, Fleming
"	−78	1.021	" "

RESISTIVITY (Continued)

Material	Temp. °C.	Resistivity ohm-cm	Authority
Silver, 99.98 %	0	1.468×10^{-6}	Dewar, Fleming
electrolytic	+98.15	2.062	" "
"	192.1	2.608	" "
	−258.6	.009	Niccolai
	−200	.357	"
	−100	.916	"
	0	1.506	"
	+100	2.15	Northrup
	200	2.80	"
	400	3.46	"
	750	6.65	"
liquid	1000	11.3	"
"	1500	15.3	"
Sodium	−180	1.0	Hackspill
	−75	2.8	"
	0	4.3	"
	55	5.4	"
liquid	116	10.2	"
"	−200	0.605	Various
	140	10.34	Northrup
Sodium-amalgam Hg 98, Na 2	0	95	
Steel			
aluminum Al 5, C 0.2	20	64	Portevin, 1909
Al 15, C 09	20	88	"
chromium Cr 13, C oz	20	60	"
Cr 40, C 08	20	71	
invar 35% Ni	20	81	Bureau of Standards
manganese	20	70	" "
nickel			
Ni 10, C 0.1	20	29	
Ni 25, C 0.1	20	39	
Ni 80, C 0.1	20	82	Portevin, 1909
piano wire	0	11.8	Stronhal, Barnes
Siemens-martin	20	18	Bureau of Standards
silicon, Si 25%	20	45	
Si 4%	20	62	
tempered glass			
hard		45.7	Stronhal, Barnes
tempered yellow		27	" "
" blue		20.5	" "
" soft		15.9	" "
titanium Ti 2.5, C 0.15,	20	16	Portevin, 1909
tungsten W 5, C 0.2	20	20	"
W 20, C 0.2	20	24	"
vanadium V 5, C 1.1	20	121	"
Strontium	20	24.8	Matthiessen
Tantalium	20	15.5	Bureau of Standards
Tellurium	19.6	200,000.	Matthiessen
Thallium, pure	−183	4.08	Dewar, Fleming
	−78	11.8	" "
	0	17.60	" "
	+98.5	24.7	" "

RESISTIVITY (Concluded)

Material	Temp. °C.	Resistivity ohm-cm	Authority
Therlo	20	47×10^{-6}	Bolton, 1909
Thorium	15	40.1	Rentschler, Marden, 1925
	20	18	Bureau of Standards
Tin	20	11.5	Bureau of Standards
	−184	3.40	Dewar, Fleming
	−78	8.8	" "
	0	13.0	" "
	+91.45	18.2	" "
	200	20.30	Northrup
	225	22.00	"
liquid	235	47.60	"
	750	61.22	"
Tin-bismuth			
Sn 90.5, Bi 9.5,	12	16	
Sn 2., Bi 98	0	244	
Tin-lead			
Sn 90, Pb 10	15	13.5	
Sn 33.3, Pb 66.7	15	16	Laport, 1897
Titanium		3.2	Shukow
Tungsten	20	5.51	Langmuir, 1916
	727	25.3	"
	1227	59.4	"
	1727	59.4	"
	2727	98.9	"
	3237	118	
Wood's metal			
Bi 56, Pb 14, Sn 14	0	52	
Zinc	−183	1.62	Dewar, Fleming
	−78	3.34	" "
	0	5.75	" "
	+92.5	8.00	
	191.5	10.37	
liquid	440	37.2	de la Rive
	100	7.95	Northrup
	300	13.25	"
	415	17.00	"
liquid	427	37.30	"
"	500	36.60	"
"	600	35.90	"
"	700	35.60	"
"	800	35.60	"
"	850	35.74	"

TEMPERATURE COEFFICIENT OF RESISTIVITY

Giving the temperature coefficient of resistivity for degrees centigrade for various metals including alloys.

Material	T °C.	α	Authority
Advance (*See constantan*)			
Aluminum	18	0.0039	Jäger, Diesselhorst, 1900
	25	.0034	Somerville, 1910
	100	.0040	"
	500	.0050	"
annealed, highest purity	0–100	.00445	Holborn, 1921
Aluminum-bronze			
Cu 97, Al 3		.00102	
Cu 90, Al 10		.00320	
Cu 6, Al 94		.00380	
Antimony	20	.0036	
Arsenic		.0042	
Bismuth	20	.004	Bureau of Standards
	0–100	.00446	Holborn, 1921
Brass	20	.002	Bureau of Standards
Cu 66, Zn 34	15	.0020	
Cu 60, Zn 40	15	.0010	
Bronze			
Cu 88, Sn 12	20	.0005	
Cadmium	20	.0038	Bureau of Standards
drawn			
annealed, pure	0–100	.00424	Holborn, 1921
	0	.0042	
Carbon		−.0005	
Climax	20	+.0007	Bureau of Standards
Cobalt	0	.0033	
	0–100	.00658	Holborn, 1921
Constantan	12	.000008	Somerville, 1911
	25	.000002	"
	100	.000033	"
	200	.000020	"
	500	.000027	"
Copper, annealed	20	.00393	Bureau of Standards
hard drawn	20	.00382	" "
	100	.0038	Somerville, 1911
	400	.0042	"
	1000	.0062	"
electrolytic	0	.0041	
pure, annealed	0–100	.00433	Holborn, 1921
Copper-manganese			
Cu 96.5, Mn 3.5		.00022	Feussner, Lindeck
Cu 95, Mn 8		.000026	" "
Cu 70, Mn 30		.00004	" "
Copper-manganese-iron			
Cu 91, Mn 7.1, Fe 1.9	0	.000120	Blood
Cu 70.6, Mn 23.2, Fe 6.2	0	.000022	"
Copper-manganese-nickel			
Cu 73, Mn 24, Ni 3	0	−.00003	Feussner, Lindeck
Eureka	0	+.00005	Drysdale, 1907
Excello	20	.00016	Bureau of Standards
German-silver			
Ni 18%	20	.0004	Bureau of Standards
Cu 60, Zn 25, Ni 15	0	.00036	Feussner, Lindeck
Gold	20	.0034	Bureau of Standards
	100	.0025	Somerville, 1910
	500	.0035	"
	1000	.0049	"
	0–100	.00400	Holborn, 1921

TEMPERATURE COEFFICIENT OF RESISTIVITY
(Continued)

Material	T °C.	α	Authority
Gold-copper-silver			
Au 58.3, Cu 26.5, Ag 15.2	0	.000574	Matthiessen
Au 66.5, Cu 15.4, Ag 18.1	0	.000529	"
Au 7.4, Cu 78.3, Ag 14.3	0	.001830	"
Gold-silver			
Au 90, Ag 10	0	.0012	
Au 67, Ag 33	0	.00065	
Ia Ia			
Cu 60, Ni 40	0	−.00003	Drysdale, 1907
Illium		+.000479	Knipp-Hall, 1922
Indium	0	.0047	
Iridium	0–100	.00411	Holborn, 1921
Iron	20	.0050	Bureau of Standards
	0	.0062	Dewar, Fleming
	25	.0052	Somerville, 1910
	100	.0068	"
	500	.0147	"
	1000	.0050	"
	0–100	.00657	Holborn, 1912
Lead	18	.0043	Jäger, Diesselhorst
pure	0–100	.00422	Holborn, 1921
Lithium	0	.0047	
	230	.0027	
Magnesium	20	.004	Bureau of Standards
	0	.0038	Vincentini, Omodei
	25	.0050	Somerville, 1910
	100	.0045	"
	500	.0036	"
	600	.0100	"
Manganese-copper	0	.000040	Feussner-Lindeck
Mn 30, Cu 70			
Manganin			
Cu 84, Mn 12, Ni 4	12	.000006	Somerville, 1910
	25	.000000	"
	100	−.000042	"
	250	−.000052	"
	475	.000000	"
	500	+.00011	"
Mercury	20	.00089	Bureau of Standards
	0	.00088	Glazebrook
Molybdenum	25	.0033	Somerville
	100	.0034	"
	1000	.0048	"
	0–100	.00435	Holborn, 1921
Monel-metal	20	.0020	Bureau of Standards
Nichrome	20	.0004	Bureau of Standards
Nickel	20	.006	Bureau of Standards
	0	.006	Vincentini
	25	.0043	Somerville
	100	.0043	"
	500	.0030	"
	1000	.0037	"
pure, annealed	0–100	.00675	Holborn, 1912
Palladium	20	.0033	Bureau of Standards
pure	0–100	.00377	Holborn
"	0	.0035	Dewar, Fleming
Phosphor-bronze	0	.0040 − .0030	

TEMPERATURE COEFFICIENT OF RESISTIVITY
(Concluded)

Material	T °C.	α	Authority
Platinite, nickel steel, Ni 46–48%	0	.003	
Platinum	20	.003	Bureau of Standards
	0	.0037	Dewar, Fleming
	0–100	.00392	Holborn, 1921
Platinum-iridium			
Pt 90, Ir 18	0	.0012	Barnes, 1888
Pt 80, Ir 20	0	.0008	"
Platinum-rhodium			
Pt 90, Rh 10	0	.0013	Le Chatelier, 1900
Platinum-silver			
Pt 33, Ag 67	0	.00024	
Potassium	0	.0055	
liquid	100	.0042	
Rheotan	0	.0004	
Rhodium	0–100	.00443	Holborn
Rose metal	0	.0020	
Rubidium	0	.0060	
Silicium bronze	0	.0038–.0023	
Silver	20	.0038	Bureau of Standards
	25	.0030	Somerville, 1910
	100	.0036	"
	500	.0044	"
pure, annealed	0–100	.00410	Holborn, 1921
Sodium	0	.0044	
liquid	120	.0033	
Steel			
invar	0	.0020	
Ni 36, C 0.2			
piano wire	0	.0032	Strouhal, Barnes
Siemens-Martin	20	.003	Bureau of Standards
Silicon			
Si 4%	20	.0008	
tempered glass hard	0	.0016	Strouhal, Barnes
tempered blue	0	.0033	" "
Tantalum	20	.0031	Bureau of Standards
	0–100	.00347	Holborn, 1921
Thallium	0	.0040	
liquid	295	.00035	
Therlo	20	.00001	Bureau of Standards
Thorium	20–1800	.0021	Rentschler, Marden, 1925
Tin	20	.0042	Bureau of Standards
Tungsten	18	.0045	Jäger, Diesselhorst
	500	.0057	Somerville
	1000	.0089	"
pure, annealed	0–100	.00465	Holborn, 1921
Wood's metal	0	.0020	
Zinc	20	.0037	Bureau of Standards
	0	.0040	
	0–100	.00415	Holborn, 1921

RESISTANCE OF ELECTROLYTES

Resistance of aqueous solutions of various salts and acids in ohms per centimeter cube for a temperature of 18° C.

(From observations by Kohlrausch.)

Salt.	Number of grams of salt in 100 grams solution.							
	5	10	15	20	25	30	40	50
Acetic acid	...	654.	616.	622.5	658.	714.	925.	1351.
Ammonium chloride	10.89	5.63	3.86	2.97	2.48			
Copper nitrate	27.4	15.7	11.7	9.82	9.17			
sulphate	52 9	31.2	23.7					
Hydrochloric acid	2.54	1.59	1.34	1.31	1.38	1.51	1.94	
Potassium iodide	29.5	14.7	.....	6.88	....	4.34	3.16	2.55
Silver nitrate	39 0	21.0	14.64	11.46	9.45	8.07	6.39	5.30
Sodium carbonate	22.2	14.2	12.0					
chloride	14.94	8.33	6.10	5.11	4.69			
hydroxide	5.08	3.20	2.89	3.06	3.68	4.95	8.61	
Sulphuric acid	4.79	2.55	1.84	1.53	1.39	1.35	1 47	1.85
Zinc chloride	20 70	13 75	..	10.96	....	10.80	11.83	15.87
sulphate	52.3	31.2	24.1	21.4	20.8	22.5		
(Concentration)	6 2	12 4	18.6	24.8	31.	37 2	43.4	
Nitric acid	3.2	1.84	1.45	1.30	1.28	1.32	1.43	
(Concentration)	8.4	12.6	16.8	21.	25.2	29.4	33 6	
Potassium hydroxide	3.67	2.66	2.19	1.96	1.85	1.84	1.91	

SAFE CARRYING CAPACITY OF COPPER WIRE

(From Collins' Design and Construction of Induction Coils, by permission.)

Brown & Sharpe gauge.	Diameter in mils.	Area in circular mils.	Number of amperes, exposed work.	Number of amperes, confined spaces.
18	40	1.624	5	3
17	45	2.048	6	4
16	51	2.583	8	6
15	57	3.257	10	8
14	64	4.106	16	12
13	72	5.178	19	14
12	81	6.530	23	17
11	91	8.234	27	21
10	102	10.380	32	25
9	114	13.090	39	29
8	128	16.510	46	33
7	144	20.820	56	39
6	162	26.250	65	45
5	182	33.100	77	53
4	204	41.740	92	63
3	229	52.630	110	75
2	258	66.370	131	88
1	289	83.690	156	105
0	325	105.500	185	125
00	365	133.100	220	150

CONDUCTIVITY OF STANDARD SOLUTIONS

Giving the conductivity in reciprocal ohms (mho) per cm. for NaCl, KCl, H_2SO_4 and $MgSO_4$ for various temperatures. Solutions are as follows: —

H_2SO_4, — maximum conductivity (18° C.); dissolve 378 g. of 97% acid in pure water and dilute to 1 liter. Density at 18° C., 1.223.

$MgSO_4$, — maximum conductivity (18° C.); dissolve in 1 liter of distilled water 552 g. of $MgSO_4 7H_2O$. Density at 18° C., 1.190.

NaCl, — solution saturated at all temperatures given. An excess of NaCl in distilled water, about 450 g. per liter. D = 1.2014 (18° C.).

KCl, — normal solution, 74.59 grams per liter of solution at 18° C. Dissolve 74.555 grams (weighed in air) of KCl and dilute to 1 liter. Density, 1.04492.

Solution.	0° C.	5°	10°	15°
H_2SO_4	0.5184	0.7952	0.6408	0.7028
$MgSO_4$	0.02877	0.03402	0.03963	0.04555
NaCl	0.1345	0.1555	0.1779	0.2014
KCl, normal	0.06541	0.07414	0.08319	0.09252
KCl, 1/10 normal	0.00715	0.00822	0.00933	0.01048
KCl, 1/100 normal	0.000776	0.000896	0.001020	0.001147

	16°	17°	18°	19°	20°
H_2SO_4	0.7151	0.7275	0.7398	0.7522	0.7645
$MgSO_4$	0.04676	0.04799	0.04922	0.05046	0.05171
NaCl	0.2062	0.2111	0.2160	0.2209	0.2259
KCl, n	0.09441	0.09631	0.09822	0.10014	0.10207
KCl, 1/10 n	0.01072	0.01095	0.01119	0.01143	0.01167
KCl, 1/100 n	0.001173	0.001199	0.001225	0.001251	0.001278

	21°	22°	23°	24°	25°
H_2SO_4	0.7768	0.7890	0.8013	0.8135	0.8257
$MgSO_4$	0.05297	0.05424	0.05551	0.05679	0.05808
NaCl	0.2309	0.2360	0.2411	0.2462	0.2513
KCl, n	0.10400	0.10594	0.10789	0.10984	0.11180
KCl, 1/10, n	0.01191	0.01215	0.01239	0.01264	0.01288
KCl, 1/100 n	0.001305	0.001332	0.001359	0.001386	0.001413

	26°	27°	28°	29°	30°
H_2SO_4	0.8378	0.8499	0.8620	0.8740	0.8860
$MgSO_4$	0.05937	0.06067	0.06197	0.06328	0.06459
NaCl	0.2565	0.2616	0.2669	0.2721	0.2774
KCl, n	0.11377	0.11574	.....	.....	.....
KCl, 1/10 n	0.01313	0.01337	0.01362	0.01387	0.01412
KCl, 1/100 n	0.002819	0.002873	0.002927	0.002981	0.003036

EQUIVALENT CONDUCTANCE OF AQUEOUS SOLUTIONS

The equivalent conductance is given in reciprocal ohms. Concentration is given in milli-equivalents of solute per liter of solution. Corrected for conductance of water except in case of the strong acids.

Substance.	Concentration milli-equivalents per liter.	18° C.	100° C.
Acetic acid	0.	347.	773.
	10.	14.50	25.1
	30.	8.50	14.7
	80.	5.22	9.05
	100.	4.67	8.10
*Ammonium acetate	0.	99.8	338.
	10.	91.7	300.
	25.	88.2	286.
*Ammonium chloride	0.	131.1	415.
	2.	126.5	399.
	10.	122.5	382.
	30.	118.1	.....
Ammonium hydroxide	0.	238.	647.
	10.	9.66	23.2
	30.	5.66	13.6
	100.	3.10	7.47
Barium ferrocyanide	0.	91.	521.
	2.	46.9	202.3
	12.5	30.4	129.8
Barium hydroxide	0.	222.	645.
	2.	215.	591.
	10.	207.	548.
	50.	191.1	478.
	100.	180.1	443.
Barium nitrate	0.	116.9	385.
	2.	109.7	352.
	10.	101.	322.
	40.	88.7	280.
	80.	81.6	258.
	100.	79.1	249.
Calcium ferrocyanide	0.	88.	512.
	100.	21.9	84.3
	200.	20.6	77.5
	400.	202.	76.2
Calcium nitrate	0.	70.4	369.
	2.	66.5	346.5
	50.	55.6	276.8
	100.	51.9	255.5
	200.	48.3	234.4

* Values have been corrected for hydrolysis.

EQUIVALENT CONDUCTIVITY OF AQUEOUS SOLUTIONS (Continued)

Substance.	Concentration milli-equivalents per liter.	18° C.	100° C.
Hydrochloric acid	0.	379.	850.
	2.	373.6	826.
	10.	368.1	807.
	80.	353.	762.
	100.	350.6	754.
Lanthanum nitrate	0.	75.4	413.
	2.	68.9	363.5
	12.5	61.4	311.2
	50.	54.	261.4
	100.	49.9	236.7
	200.	46.	210.8
Magnesium sulphate	0.	114.1	426.
	2.	94.3	302.
	10.	76.1	234.
	20.	67.5	190.
	40.	59.3	160.
	80.	52.	136.
	100.	49.8	130.
	200.	43.1	110.
Nitric acid	0.	377.	826.
	2.	371.2	806.
	10.	365.	786.
	50.	353.7	750.
	100.	346.4	728.
Phosphoric acid	0.	338.3	730.
	2.	283.1	498.
	10.	203.	308.
	50.	122.7	168.
	100.	95.7	128.
Potassium chloride	0.	130.1	414.
	2.	126.3	393.
	10.	122.4	377.
	80.	113.5	342.
	100.	112.	336.
Potassium citrate	0.	76.4	420.
	2.	71.	381.2
	5.	67.6	357.2
	50.	54.4	273.
	100.	50.2	247.5
	300.	43.5	209.5
Potassium nitrate	0.	80.8	384.
	2.	78.6	370.3
	12.5	75.3	351.5

EQUIVALENT CONDUCTIVITY OF AQUEOUS SOLUTIONS (Continued)

Substance.	Concentration milli-equivalents per liter.	18° C.	100° C.
Potassium nitrate	50.	70.7	326.1
	100.	67.2	308.5
Potassium ferrocyanide	0.	98.4	527.
	2.	84.8	427.6
	50.	58.2	272.4
	100.	53.	245.
	206.	48.8	222.3
	400.	45.4	203.1
Potassium oxalate	0.	79.4	419.
	2.	74.9	389.3
	50.	63.	312.2
	100.	59.3	288.9
	200.	55.8	265.1
Potassium sulphate	0.	132.8	455.
	2.	124.8	402.
	10.	115.7	365.
	40.	104.2	320.
	80.	97.2	294.
	100	95.	286.
Silver nitrate	0.	115.8	367.
	2.	112.2	353.
	10.	108.	337.
	20.	105.1	326.
	40.	101.3	312.
	80.	96.5	294.
	100.	94.6	289.
Sodium acetate	0.	78.1	285.
	2.	74.5	268.
	10.	71.2	253.
	80.	63.4	221.
Sodium chloride	0.	109.	362.
	2.	105.6	349.
	10.	102.	336.
	80.	93.5	301.
	100.	92.0	296.
Sodium hydroxide	0.	216.5	594.
	2.	212.1	582.
	20.	205.8	559.
	50.	200.6	540.
Sulphuric acid	0.	383.	891.
	2.	353.9	571.
	10.	309.	446.
	50.	253.5	384.
	100.	233.3	369.

THE EQUIVALENT CONDUCTANCE OF THE SEPARATE IONS

(From Smithsonian Physical Tables.)

Ion.	0°	18°	25°	50°	75°	100°	128°	156°
K	40.4	64.6	74.5	115	159	206	263	317
Na	26.	43.5	50.9	82	116	155	203	249
NH_4	40.2	64.5	74.5	115	159	207	264	319
Ag	32.9	54.3	63.5	101	143	188	245	299
$\frac{1}{2}Ba$	33.	55	65.	104	149	200	262	322
$\frac{1}{2}Ca$	30.	51	60.	98	142	191	252	312
$\frac{1}{3}La$	35.	61.	72.	119	173	235	312	388
Cl	41.1	65.5	75.5	116	160	207	264	318
NO_3	40.4	61.7	70.6	104	140	178	222	263
$C_2H_3O_2$	20.3	34.6	40.8	67	96	130	171	211
$\frac{1}{2}SO_4$	41.	68	79.	125	177	234	303	370
$\frac{1}{2}C_2O_4$	39.	63	73.	115	163	213	275	336
$\frac{1}{3}C_6H_5O_7$	36.	60.	70.	113	161	214		
$\frac{1}{4}Fe(CN)_6$	58.	95.	111.	173	244	321		
H	240.	314.	350.	465	565	644	722	777
OH	105.	172.	192.	284	360	439	525	592

RESISTIVITY OF DIELECTRICS

Giving the volume resistivity ρ, the variation of the volume resistivit with temperature, given as the ratio of the value at 20° C. to that at 30° C and the surface resistivity for various dielectrics. The surface resistivity the resistance between the opposite edges of a centimeter square. A larg part of the data are from Curtis, Bulletin of the Bureau of Standards 191 Temperatures, unless otherwise stated, are 22° C. The numbers in parenthes refer to the source of information.

Material	Volume resistivity			Surface resistivity, ohm-cm	
	Temp. °C.*	ρ ohm-cm	ρ^{10}/ρ^{30}	Humidity 50%	Humidity 90
Amberite	22	5×10^{16}		2×10^{15}	3×10^{12}
Amber		5×10^{16}		6×10^{14}	1×10^{11}
Bakelite†					
No. 1		2×10^{11}		3×10^{11}	2×10^{8}
140		2×10^{7}	2.4	3×10^{9}	2×10^{5}
150		4×10^{12}	3.6	3×10^{12}	4×10^{9}
190		1×10^{11}	3.6	1×10^{11}	5×10^{8}
L 558		2×10^{16}	2.6	8×10^{15}	8×10^{14}
G5074		4×10^{10}		3×10^{11}	5×10^{6}
5199RGRB		5×10^{12}		6×10^{12}	1×10^{10}
5200		4×10^{11}	5.3	1×10^{12}	5×10^{9}
Bakelite micarta		5×10^{10}	2.4	2×10^{10}	1×10^{8}
Beeswax					
yellow, unrefined		20×10^{14}	16.0	**6×10^{14}	**5×10^{14}
	20	8×10^{14}(1)			
white		6×10^{14}			
	22	5×10^{14}(1)			
Celluloid		2×10^{10}	1.8	5×10^{10}	2×10^{9}
	16	4×10^{10}(2)			
Ceresin		>5×10^{18}		>**1×10^{17}	>**1×10^{17}
Condensite					
black		4×10^{10}	2.9	6×10^{10}	8×10^{8}
yellow		4×10^{10}	2.9	3×10^{11}	6×10^{9}
Dielectrite		5×10^{12}	3.0	5×10^{11}	4×10^{7}
Duranoid		3×10^{15}		6×10^{12}	3×10^{8}
Electrose, No. 8		2×10^{16}		1×10^{15}	2×10^{12}
black		1×10^{14}	2.0	1×10^{12}	6×10^{9}
yellow		5×10^{15}	2.3	3×10^{14}	5×10^{8}
Fibre, hard		2×10^{10}	3.2	5×10^{9}	3×10^{7}
red		5×10^{9}	2.6	2×10^{10}	2×10^{8}
	20	1×10^{8}(3)			
Galalith,					
black		2×10^{10}		8×10^{10}	3×10^{9}
white		1×10^{10}		4×10^{10}	6×10^{8}
Glass, German		5×10^{13}	2.5	4×10^{11}	6×10^{8}
	18	5×10^{11}(4)			
Kavalier		8×10^{15}	4.5	4×10^{12}	1×10^{8}
	17	1×10^{16}(5)			
opal		1×10^{12}	2.8		
plate, commercial		2×10^{13}	3.2	5×10^{10}	2×10^{6}
ordinary	20	9×10^{13}			
Bohemian	20	6×10^{12}			
Glyptol		1×10^{16}	3.0		
Gummon		3×10^{12}	1.4	2×10^{12}	3×10^{8}
Halowax 1001		2×10^{13}	2.5	*6×10^{15}	*5×10^{11}
5055 B		2×10^{16}			

* Temperature is .22°C. except where otherwise stated.
† For composition of bakelite samples see table following.
** Leakage resistivity.

RESISTIVITY OF DIELECTRICS (Continued)

Material	Volume resistivity			Surface resistivity, ohm-cm	
	Temp. °C.	ρ ohm-cm	ρ^{20}/ρ^{30}	Humidity 50%	Humidity 90%
Hard Rubber		1×10^{18}		3×10^{15}	2×10^{9}
		2×10^{15} (6)			
		3×10^{16} (?)			
Hemit		1×10^{10}	1.2	1×10^{10}	3×10^{8}
Insulate		8×10^{15}	1.0	3×10^{14}	3×10^{11}
Ivory		2×10^{8}	1.5	5×10^{9}	1×10^{9}
Khotinsky Cement		2×10^{15}	11.0	*7×10^{14}	*5×10^{11}
Lavite		2×10^{10}		1×10^{11}	1×10^{8}
Marble					
Italian		1×10^{11}		3×10^{9}	2×10^{7}
		1×10^{10} (?)			
Pink Tennessee		5×10^{9}		5×10^{9}	3×10^{7}
Blue Vermont		1×10^{9}		8×10^{9}	1×10^{7}
Mica	20	9×10^{15} (6)			
black African		4×10^{13}		3×10^{12}	3×10^{9}
brown African		2×10^{15}	1.2	3×10^{11}	1×10^{9}
colorless		2×10^{17}	2.0	2×10^{13}	8×10^{9}
India ruby		5×10^{13}	2.7	1×10^{10}	9×10^{7}
stained		2×10^{13} (7)			
Indian ruby		5×10^{16}	1.0		
slightly stained		4×10^{13} (7)			
Moulded mica		1×10^{15}	1.2	5×10^{13}	3×10^{9}
Paraffin (special)		$>5\times10^{18}$		*9×10^{15}	*6×10^{15}
parowax		1×10^{16}	2.0		
		3×10^{18} (8)			
	17	5×10^{16} (5)			
Porcelain, unglazed		3×10^{14}	1.6	6×10^{11}	5×10^{6}
glazed				2×10^{12}	5×10^{8}
Quartz crystal					
∥ to axis	17	2×10^{14} (5)			
	20	1×10^{14} (6)			
⊥ to axis	17	2×10^{16} (5)			
	20	3×10^{16} (6)			
fused		$>5\times10^{18}$		3×10^{12}	2×10^{8}
cleaned with chromic acid				3×10^{14}	2×10^{12}
Redmonite		2×10^{14}	2.0	5×10^{13}	3×10^{10}
Rosin		5×10^{16}	3.6	5×10^{14}	2×10^{14}
	17	7×10^{15} (5)			
Sealing wax		8×10^{15}	0.9	2×10^{15}	9×10^{12}
	19	1×10^{15} (1)			
Shellac		1×10^{16}	1.5	5×10^{12}	6×10^{9}
		9×10^{15} (?)			
Slate		1×10^{8}		9×10^{6}	1×10^{6}
		2×10^{8} (?)			
Stabalite		3×10^{13}	1.6	2×10^{13}	4×10^{7}
Sulfur		1×10^{17}	4.9	7×10^{15}	1×10^{14}
	17	8×10^{15} (5)			
Tegit		2×10^{13}	1.4		
Tetrachlornaphthalene		5×10^{13}	2.9	*1×10^{14}	*1×10^{14}
Wood, paraffined					
mahogany		4×10^{13}		3×10^{12}	5×10^{9}
maple		3×10^{16}	3.6	8×10^{11}	2×10^{9}
poplar		5×10^{11}	3.6	1×10^{12}	1×10^{9}

* Leakage resistivity.

RESISTIVITY OF DIELECTRICS (Continued)

Description of Materials

Amberite is made by compressing scrap amber.

Bakelite. A phenol condensation product, with various fillers. The various samples were made as follows:

Number	Percent pure Bakelite	Filler	Phenolic Body	Condensing Agent
1		Paper	Cresols	Ammonia
140	50	Vegetable	Phenol	Caustic soda
150	50	Fiber	"	Ammonia
190	50	"	Cresols	"
5199	50	"	Phenol	"
5200	50	Fiber & clay	"	"
5074	35	Talc	"	Caustic soda
588	100	None	"	"
1 Regular	100	None	Cresols	Ammonia

Ceresin is a waxy material refined from the mineral ozokerite, m.p. below 100° C., sp. gr. 0.91–0.97. Condensite is a phenol condensation product.

Hard fiber, soft cotton paper, treated with zinc chloride, dried and pressed.

Galalith is made from the casein of milk.

Kavalier glass is hard combustion tubing having a large potassium and calcium content.

Glyptol is an artificial resin resembling amber.

Gummon, hemit, and tegit are coal tar products.

Halowax, chlorinated naphthalenes.

Moulded mica is ground mica and asbestos with shellac.

Stabalite is a rubber compound.

References

1. Dietrich, 1909
2. Addenbrooke, 1911
3. Rayner, 1905
4. Campbell, 1913
5. Thornton, 1910
6. Curie, 1889
7. Wilson-Mitchell, 1905
8. Braum, 1887

Liquids

Resistance in ohms per centimeter cube.

Substance.	Temp. ° C.	Resistance, ohms.
Alcohol, ethyl	15	$.3 \times 10^6$
methyl		$.14 \times 10^6$
Oils, olive		5×10^{12}
paraffin		1×10^{16}
Petroleum		2×10^{16}
Water distilled	18	0.5×10^6

Fused Salts

(Poincaré.)

Substance.	Temp. ° C.	Resistance, ohms.
Calcium chloride	750	.862
Potassium bromide	750	.714
chlorate fused	355	2.20
Silver nitrate	350	.820
Sodium chloride fused	750	.294

THERMOELECTRIC POWER

The table gives the electromotive force in microvolts per degree difference in temperature between the two junctions, for various metals with lead. The temperature given is the mean temperature of the two junctions. A is the thermo-electric power at 0 ° C. and B the coefficient in the equation for the thermoelectric power at any temperature,

$$Q = A + Bt,$$

where t is the mean temperature of the two junctions. The thermoelectric power of any two metals in the table may be found by subtracting the value for the first from that of the second, a positive difference indicating that the current will flow from the cold to the hot junction in the second metal.

The sign of the values given is so chosen that if A is positive the current flows in the metal listed from the cold to the hot junction. When B is positive Q increases with the temperature.

(Principally from the Smithsonian Physical Tables.)

Metal.	A microvolts.	B microvolts per ° C.	Temp. ° C.	Thermoelectric power, microvolts.	Neutral point.
Aluminum[1]	0.76	−0.0039	20	0.68	195
Antimony comm'l.-pressed wire[2]	.....	.....	20	−6.0	
pure[3]	.....	−0.018	−100–+100	−1.49	
Argentan[1]	11.94	0.0506	20	12.95	− 236
Arsenic[4]	.....	.....	20	13.56	
Bismuth comm'l.-pressed wire[2]	.....	.....	20	97.0	
pure pressed wire[2]	.....	.....	20	89.0	
commercial[4]	.....	.....	50	39.9	
Brass[5]	.....	−0.0026	0.260	−0.65	
Cadmium[1]	− 2.63	−0.0424	20	−3.48	− 62
Cobalt[2]	.....	.....	20	22.	
Constantin	.....	.....	50	+19.3	
Copper[1]	− 1.34	−0.0094	20	−1.52	− 143
commercial[2]	.....	.....	20	−0.10	
German silver[3]	.....	+0.019	−100–+100	+10.7	
Gold[1]	− 2.80	−0.0101	20	−3.0	− 277
Iron[1]	−17.15	0.0482	20	−16.2	356
pianoforte wire[2]	.....	.....	20	−17.5	
Magnesium[1]	− 2.22	0.0094	20	−2.03	236
Manganin[3]	.....	0.003	−100–+100	1.12	
Mercury[3]	.....	.....	20	0.413	
Nickel[4]	.....	.....	50	15.50	
Paladium[1]	6.18	0.0355	20	6.9	− 174
Platinum, pure[6]	.....	+0.011	0–200	+3.04	
Platinum-iridium alloys: 85%Pt+15%Ir[1]	− 7.90	−0.0062	20	−8.03	−1274
90%Pt+10%Ir[1]	− 5.90	0.0133	20	−5.63	444
Selenium[3]	.....	.....	20	−807.	
Silver[1]	− 2.12	−0.0147	20	−2.41	− 144
pure hard[2]	.....	.....	20	−3.00	
Steel[1]	−11.27	0.0325	20	− 10.62	347
Tellurium[2]	.....	.....	20	−502.	
Tin, commercial[4]	.....	.....	50	−0.33	
Tin[1]	0.43	−0.0055	20	0.33	78
Zinc[1]	− 2.32	−0.0238	20	−2.79	− 98

OBSERVERS: [1] Tait. [2] Matthiesen. [3] Dewar & Fleming. 1895. [4] Ed. Becquerel. [5] Steinmann. [6] Noll, 1894.

THERMOELECTRIC POWER

Metal	A micro volts	B micro volts per °C.	Temp. °C.	Thermo. electric power	Neutral point
Calcium	....	....	50	+8.9	....
Gallium	....	....	20	−0.2	....
Germanium	....	....	−192	+160.	300
	....	....	+125	425.	....
	....	....	550	−175.	....
	....	....	675	−125.	....
Molybdenum	....	....	20	+5.9	....
Thallium	....	....	20	+0.8	....
Tungsten	....	....	20	−2.0	....

HYSTERESIS

The dissipation of energy due to hysteresis in metals is expressed by Steinmetz by the following equation:

$$E = \eta B^{1.6}$$

Values of η as found by Steinmetz appear below. C. G. S. units.

Material	
Iron	
Norway iron	.00227
Wrought bar	.00326
Commercial ferrotype plate	.00548
Annealed " "	.00458
Thin tin plate	.00286
Medium thickness tin plate	.00425
Steel	
Soft galvanized wire	.00349
Annealed cast steel	.00848
Soft annealed cast steel	.00457
Very soft annealed cast steel	.00318
Same above tempered in cold water	.02792
Tool steel glass hard tempered in water	.07476
" " tempered in oil	.02670
" " annealed	.01899
Cast iron	
Gray cast iron	.01300
" " " 1% aluminium	.01365
" " " ½% "	.01456
Nickel	
Soft wire	.0122
Annealed wire	.0156
Hardened	.0384
Cobalt	
2% of iron	.0210
Iron Filings	
180 cycles per second	.0457
114 " " "	.0396
79–91 " " "	.0373

MAGNETIC CONSTANTS OF IRON

Permeability of Transformer Iron

Giving M, the total magneto motive force applied. M/l, the magneto motive force per unit length of iron circuit. B the total induction, B/a the induction per unit cross-section of iron, M/B, the magnetic reluctance of the iron circuit and Bl/Ma, the permeability; showing the typical relations of the magnetic constants for varying field.

(From Smithsonian Tables.)

M.	M/l.	B.	B/a.	Reluctance $M/B=K$.	Permeability $Bl/Ma=\mu$.
20	0.597	218×10^3	1406	0.917×10^{-4}	2360
40	1.194	587	3790	0.681	3120
60	1.791	878	5660	0.683	3180
80	2.388	1091	7040	0.734	2960
100	2.985	1219	7860	0.819	2640
120	3.582	1330	8580	0.903	2410
140	4.179	1405	9060	0.994	2186
160	4.776	1475	9510	1.090	2000
180	5.373	1532	9880	1.180	1850
200	5.970	1581	10200	1.270	1720
220	6.567	1618	10430	1.360	1590
260	7.761	1692	10910	1.540	1410

MAGNETIC PROPERTIES OF IRON AND STEEL

(From Gumlich, 1909.)

Sample.	Coercive force.	Residual B.	Maximum permeability.	B for H = 150.	$4\pi I$ for saturation.
Electrolytic iron	2.83	11400	1850	19200	21620
The same annealed	0.36	10800	14400	18900	21630
Cast steel	1.51	10600	3550	18800	21420
The same annealed	0.37	11000	14800	19100	21420
Steel hardened	52.4	7500	110	11700	18000
Cast iron	11.4	5100	240	10400	16400
The same annealed	4.6	5350	600	11000	16800
Electrical iron in sheets annealed	1.30	9400	3270	18200	20500

SATURATION CONSTANTS FOR MAGNETIC SUBSTANCES

Substance.	Field intensity. (For saturation.)	Induced magnetization.	Substance.	Field intensity. (For saturation.)	Induced magnetization.
Cobalt	9000	1300	Nickel, hard	8000	400
Iron, wrought	2000	1700	annealed	7000	515
cast	4000	1200	Vicker's steel	15000	1600
Manganese steel	7000	200			

MAGNETIC SUSCEPTIBILITY OF VARIOUS SUBSTANCES

METALS

Magnetic susceptibility or the ratio of the magnetic moment per unit volume to the magnetizing field is given for various substances. The value is negative for diamagnetic bodies, positive for paramagnetic bodies.

(C. G. S. Electromagnetic units.)

Substance.	Temp ° C.	Susceptibility (vacuum =0).	Observer.
Aluminum	.....	-1.8×10^{-6}	
Antimony	.....	−4.6	Curie, 1895
Bismuth	.....	−13.3	Curie, 1895
Copper	.....	−1.33	Becquerel, 1855
Gold	.....	−4 5	Hanriot & Raoult, 1911
Lead	.....	−1.21	Becquerel
Mercury	15	−2.1	St. Mayer
Platinum	.....	+29 0	J. Königsberger, 1898
Selenium	20	−1.54	Curie, 1895
Silver	.....	−1.8	Becquerel, 1855
Tellurium	20	−1.94	Curie, 1895
Zinc	.....	−1.16	Owen, 1912
Iron annealed	.....	$+37.4\times10^{1}$	For weak fields
Nickel	.....	$+4.\times10^{1}$	For H =100 C. G. S.
Steel tempered	.....	$+3.4\times10^{1}$	For weak fields

INORGANIC COMPOUNDS

Substance.	Temp. ° C.	Susceptibility (vacuum =0).	Observer.
Boric acid	.....	-0.88×10^{-6}	Meslin, 1906
Cobalt sulphate ($7H_2O$)	.....	+76.3	Meslin, 1906
Copper sulphate ($5H_2O$)	.....	+13.4	Mlle. Feytis, 1911
Ferric chloride	.....	+287.	Meslin, 1906
Ferrous sulphate ($7H_2O$)	.....	+95.3	Meslin, 1906
Glass	.....	−0.15	Faraday, 1853
Nickel sulphate ($7H_2O$)	.....	+37.	Meslin, 1906
Potassium bichromate	.....	+0.36	Meslin, 1906
Potassium chloride	18	−1.09	Curie, 1895
Potassium ferrocyanide	.....	+16.0	Meslin, 1906
Quartz	20	−1.20	J. Königsberger
Sodium chloride	22	−1.02	Meslin, 1906

LIQUIDS

Substance.	Temp. ° C.	Susceptibility (vacuum =0).	Observer.
Acetic acid	.....	−0.61	Meslin, 1906
Alcohol, ethyl	.....	−0.65	Meslin, 1906
Benzene	.....	−0.69	Meslin, 1906
Chloroform	.....	−0.86	Meslin, 1906
Ether	.....	−0.61	Meslin, 1906
Glycerine	.....	−0.81	Meslin, 1906
Sulphuric acid	.....	−0.77	Quincke, 1885
Water	20	−0.72	Piccard, 1912

VARIATION OF RESISTANCE DUE TO A MAGNETIC FIELD

Bismuth

The table shows the proportional values of the resistance for values of the magnetic field from 0 to 35,000 and for different temperatures. The resistance at 0° C. and H =0 is taken as 1.

Proportional values of resistance.
(From Smithsonian Tables.)

H. Gauss.	−192°	−135°	−100°	−37°	0°	+18°	+60°	+100°	+183°
0	0.40	0.60	0.70	0.88	1.00	1.08	1.25	1.42	1.79
2000	1.16	0.87	0.86	0.96	1.08	1.11	1.26	1.43	1.80
4000	2.32	1.35	1.20	1.10	1.18	1.21	1.31	1.46	1.82
6000	4.00	2.06	1.60	1.29	1.30	1.32	1.39	1.51	1.85
8000	5.90	2.88	2.00	1.50	1.43	1.42	1.46	1.57	1.87
10000	8.60	3.80	2.43	1.72	1.57	1.54	1.54	1.62	1.89
12000	10.8	4.76	2.93	1.94	1.71	1.67	1.62	1.67	1.92
14000	12.9	5.82	3.50	2.16	1.87	1.80	1.70	1.73	1.94
16000	15.2	6.95	4.11	2.38	2.02	1.93	1.79	1.80	1.96
18000	17.5	8.15	4.76	2.60	2.18	2.06	1.88	1.87	1.99
20000	19.8	9.50	5.40	2.81	2.33	2.20	1.97	1.95	2.03
25000	25.5	13.3	7.30	3.50	2.73	2.52	2.22	2.10	2.09
30000	30.7	18.2	9.8	4.20	3.17	2.86	2.46	2.28	2.17
35000	35.5	20.35	12 2	4.95	3.62	3.25	2.69	2.45	2.25

Various Metals

The table gives the per cent. change in the resistance due to a field of 10,000 gauss with respect to the value at 0° C. and H =0.

(Grumach.)

Metal.	Per cent. change.	Metal	Per cent. change.
Cadmium	+0.03	Palladium	+0.001
Cobalt	−0.53	Platinum	+0.0005
Copper	+0.004	Silver	+0.004
Gold	+0.003	Tantalum	+0.0003
Lead	+0.0004	Tin	+0.002
Nickel	−1.4	Zinc	+0.01

INTERNAL RESISTANCE OF VARIOUS VOLTAIC CELLS

The internal resistance is subject to large variations; the values given can be considered only approximate.

Cell.	Resistance, ohms.	Cell.	Resistance, ohms.
Edison-Lalande	0.03	Grove	0.1–0.2
Daniell	0.85	Bunsen	0.1–0.2
Gravity	1–5	Bichromate	0.08–0.40
Silver chloride	4.	Storage	0.004–0.02
Dry cell	0.2–1.0	Clark standard	20–50
Leclanché	0.4–0.2	Weston standard	20–50

HALL EFFECT

If a strip of metal of thickness t, in which a current i is flowing (longitudinally) is subjected to a transverse magnetic field H, a difference of potential E is produced at opposite points at the side of the strip. $E = R \times Hi/t$ where R is a constant specific with different metals and E, H, i and t in C. G. S. units. The table gives values obtained at ordinary room temperatures, 18-24° C. If the value of R is independent of the field, or nearly so, the field intensity is not given. The positive sign indicates that if a strip of metal were considered to be in the plane of this page with its long axis horizontal, the primary current flowing from left to right and the magnetic field directed away from the observer, normal to the plane of the strip, the upper edge of the strip would be at a higher potential than the lower.

Substance.	Field strength, gausses.	R.	Observer.
Aluminum	.....	−.00038	Von Ettinghausen & Nernst, 1886
Antimony	1750	+0.219	Barlow, 1903
Bismuth	1650	−10.27	Von Ettinghausen & Nernst, 1886
Bismuth	11100	−4.95	Von Ettinghausen & Nernst, 1886
Cadmium	.....	+.00055	Von Ettinghausen & Nernst, 1886
Carbon	.....	−.17	Von Ettinghausen & Nernst, 1886
Cobalt	3463	+.24	Hall, 1885
Copper	.....	−.00052	Hall, 1885
Gold	.....	−.00066	Hall, 1885
Iron	6290	+.0108	Zahn, 1904
Lead	.....	.00009	Von Ettinghausen & Nernst, 1886
Magnesium	.....	−.00094	Von Ettinghausen & Nernst, 1886
Nickel	10620	−.0047	Zahn, 1904
Platinum	.....	−.00024	Von Ettinghausen & Nernst, 1886
Silver	.....	−.00085	Von Ettinghausen & Nernst, 1886
Tellurium	.....	+530	Von Ettinghausen & Nernst, 1886
Tin	.....	−.00004	Von Ettinghausen & Nernst, 1886
Zinc	.....	+.00033	Barlow, 1903

ELECTROCHEMICAL EQUIVALENTS

Grams per coulomb.

Element.	Valence.	Equiv.	Element.	Valence.	Equiv.
Aluminum	3	$.0936 \times 10^{-3}$	Iron	3	$.1929 \times 10^{-3}$
Antimony	3	.4153	Lead	2	1.0731
Antimony	5	.2492	Magnesium	2	.1260
Bismuth	3	.7185	Mercury	1	2.0788
Cadmium	2	.5824	Mercury	2	1.0394
Chromium	3	.1796	Nickel	2	.3040
Cobalt	2	.3055	Oxygen	2	.0829
Copper	1	.6588	Platinum	2	1.0104
Copper	2	.3294	Silver	1	1.1180
Gold	3	.6812	Tin	2	.6166
Hydrogen	1	.0105	Tin	4	.3083
Iron	2	.2893	Zinc	2	.3387

MAGNETIC INCLINATION OR DIP AND HORIZONTAL INTENSITY

The mean or limiting values are given for the territory covered by the State named. The horizontal intensity is given in gausses. The table is compiled from the results of the U. S. Coast and Geodetic Survey for 1911 and 1912.

State.	Dip, degrees.	Horizontal intensity.
Alabama	62. to 66.	.23 to .26
Alaska	67. 74.	.16 .21
Arizona	59.	.27
Arkansas	63. 65.	.24 .25
California	58. 62.	.25 .27
Colorado	67. 68.	.22 .23
Connecticut	72. 73.	.17 .18
Delaware	70. 71.5	.19 .20
Florida	57. 58.	.27 .29
Georgia	62. 66.	.23 .26
Hawaii	39.	.29
Idaho	69.	.21
Indiana	69. 72.	.18 .21
Iowa	71. 73.	.18 .20
Kansas	67. 69.	.21 .23
Kentucky	68. 70.	.20 .22
Maine	74. 76.	.14 .16
Maryland	70.	.20
Massachusetts	73.	.17
Michigan	73. 76.	.15 .18
Mississippi	61. 66.	.24 .26
Missouri	67. 71.	.20 .22
Montana	70. 72.	.18 .20
Nebraska	70. 71.	.20
New Hampshire	73. 74.	.16 .17
New Jersey	71.	.19
New Mexico	63. 65.	.24 .25
New York	74.	.16 .17
North Carolina	66. 68.	.21 .23
North Dakota	74. 77.	.15 .16
Ohio	71. 73.	.18 .20
Oklahoma	63. 67.	.23 .25
Oregon	68. 69.	.21
Pennsylvania	71. 72.	.18 .19
Philippines	0. 23.	.37 .39
Porto Rico	49. 50.	.29 .30
South Carolina	66. 67.	.23
South Dakota	71. 74.	.17 .19
Tennessee	66. 68.	.22 .23
Texas	57. 63.	.25 .29
Utah	66. 67.	.22 .23
Vermont	73. 75.	.16 .17
Virginia	68. 70.	.20 .21
Washington	71.	.19
West Virginia	70.5	.20
Wisconsin	74. 76.	.15 .17
Wyoming	68. 72.	.19 .22

MAGNETIC DECLINATION

An annual decrease in declination is indicated by the negative sign, an increase by the positive.

(From U. S. Coast and Geodetic Survey)

State.	Station.	Magnetic declination in degrees and tenths.					Ann. Chge. (1910).
		1870	1880	1890	1900	1910	
Ala.	Montgomery	4.5 E	3.9 E	3.2 E	2.8 E	2.9 E	−.012
Alaska	Sitka	29.0 E	29.3 E	29.5 E	29.7 E	30.2 E	
	Kodiak	25.6 E	25.1 E	24.7 E	24.4 E	24.1 E	
	Unalaska	20.1 E	19.6 E	19.0 E	18.3 E	17.5 E	
	St. Michael	....	24.7 E	23.1 E	22.1 E	21.4 E	
Ariz.	Holbrook	13.8 E	13.7 E	13.4 E	13.5 E	13.9 E	+.072
	Prescott	13.7 E	13.6 E	13.5 E	13.7 E	14.3 E	+.077
Ark.	Little Rock	8.2 E	7.6 E	7.0 E	6.6 E	6.9 E	+.023
Cal.	Los Angeles	14.4 E	14.6 E	14.6 E	14.9 E	15.5 E	+.083
	San José	17.3 E	17.5 E	17.5 E	17.8 E	18.5 E	+.075
Cal.	Redding	18.1 E	18.2 E	18.3 E	18.6 E	19.3 E	+.075
Colo.	Pueblo	13.8 E	13.5 E	13.0 E	12.9 E	13.3 E	+.050
	Glenwood Sp.	16.3 E	16.1 E	15.7 E	15.6 E	16.1 E	+.062
Conn.	Hartford	8.7 W	9.4 W	9.8 W	10.4 W	11.0 W	+.097
Del.	Dover	4.7 W	5.3 W	5.9 W	6.4 W	7.0 W	+.080
D. C.	Washington	2.4 W	3.0 W	3.6 W	4.2 W	4.7 W	+.075
Fla.	Jacksonville	3.1 E	2.4 E	1.8 E	1.3 E	1.2 E	−.033
	Tampa	3.9 E	3.3 E	2.8 E	2.3 E	2.0 E	−.013
Ga.	Macon	3.9 E	3.2 E	2.6 E	2.1 E	2.0 E	−.033
Hawaii	Honolulu	9.5 E	9.8 E	10.1 E	10.4 E	10.6 E	
Idaho	Pocatello	17.8 E	17.9 E	17.7 E	17.8 E	18.4 E	+.067
	Boise	18.6 E	18.7 E	18.6 E	18.8 E	19.4 E	+.075
Ill.	Bloomington	5.4 E	4.7 E	4.1 E	3.6 E	3.4 E	−.013
Ind.	Indianapolis	3.2 E	2.6 E	2.0 E	1.4 E	1.1 E	−.030
Ia.	Des Moines	9.7 E	9.1 E	8.4 E	7.9 E	8.1 E	+.017
Kans.	Emporia	11.2 E	10.7 E	10.1 E	9.8 E	10.1 E	+.030
	Ness City	12.2 E	11.9 E	11.4 E	11.1 E	11.4 E	+.040
Ky.	Lexington	2.5 E	1.9 E	1.2 E	0.7 E	0.5 E	−.033
	Princeton	5.6 E	5.0 E	4.3 E	3.8 E	3.7 E	−.017
La.	Alexandria	8.0 E	7.4 E	6.9 E	6.6 E	6.8 E	+.030
Me.	Eastport	18.2 W	18.6 W	18.7 W	19.0 W	19.4 W	+.100
	Portland	12.8 W	13.4 W	13.9 W	14.4 W	14.8 W	+.100
Md.	Baltimore	3.8 W	4.4 W	5.0 W	5.6 W	6.1 W	+.075
Mass.	Boston	11.0 W	11.5 W	12.0 W	12.6 W	13.1 W	+.100
	Pittsfield	9.3 W	10.0 W	10.4 W	11.0 W	11.5 W	+.097
Mich.	Marquette	4.6 E	3.8 E	3.0 E	2.3 E	2.0 E	−.027
	Lansing	2.1 E	1.3 E	0.5 E	0.0 E	0.4 E	+.040
Minn.	Northome	10.0 E	9.3 E	8.6 E	8.0 E	8.1 E	+.017
	Mankato	10.9 E	10.4 E	9.5 E	9.0 E	9.1 E	+.020
Miss.	Jackson	7.5 E	6.9 E	6.4 E	6.0 E	6.2 E	+.017
Mo.	Sedalia	9.4 E	8.7 E	8.0 E	7.6 E	7.9 E	+.020
Mont.	Forsyth	18.6 E	18.4 E	17.9 E	17.8 E	18.3 E	+.050
	Helena	19.8 E	19.6 E	19.4 E	19.5 E	20.0 E	+.062
Nebr.	Hastings	11.7 E	11.2 E	10.5 E	10.2 E	10.5 E	+.033
	Alliance	15.3 E	14.8 E	14.3 E	14.2 E	14.5 E	+.043

MAGNETIC DECLINATION (Continued)

An annual decrease in declination is indicated by the negative sign and an increase by the positive.

(From U. S. Coast and Geodetic Survey.)

State.	Station.	Magnetic declination in degrees and tenths.					Ann. Chge. (1910)
		1870	1880	1890	1900	1910	
Nevada...	Elko.....	17.7 E	17.7 E	17.6 E	17.8 E	18.3 E	+.077
	Hawthorne.....	16.9 E	17.0 E	17.0 E	17.3 E	17.8 E	+.083
N. H.....	Hanover.....	11.1 W	11.6 W	12.0 W	12.5 W	13.0 W	+.100
N. J.....	Trenton.....	6.0 W	6.7 W	7.2 W	7.8 W	8.4 W	+.082
N. Mex...	Santa Rosa.....	12.7 E	12.5 E	12.1 E	12.0 E	12.4 E	+.060
N. Mex...	Laguna.....	13.6 E	13.4 E	13.0 E	13.0 E	13.5 E	+.062
N. Y.....	Albany.....	9.1 W	9.8 W	10.2 W	10.8 W	11.4 W	+.093
	Elmira.....	5.4 W	6.3 W	7.0 W	7.6 W	8.1 W	+.075
N. C.....	Newbern.....	1.0 W	1.6 W	2.2 W	2.8 W	3.3 W	+.057
	Salisbury.....	1.5 E	0.8 E	0.2 E	0.4 W	0.7 W	+.047
N. Dak...	Jamestown.....	14.0 E	13.5 E	12.7 E	12.4 E	12.8 E	+.030
	Dickinson.....	17.4 E	17.0 E	16.4 E	16.2 E	16.6 E	+.040
Ohio.....	Columbus.....	1.2 E	0.6 E	0.0 E	0.7 W	1.1 W	+.047
Okla.....	Okmulgee.....	9.8 E	9.4 E	8.8 E	8.5 E	8.9 E	+.033
	Enid.....	10.9 E	10.5 E	9.9 E	9.7 E	10.1 E	+.043
Oregon....	Sumpter.....	20.0 E	20.2 E	20.2 E	20.4 E	21.0 E	+.077
	Detroit.....	20.1 E	20.4 E	20.5 E	20.8 E	21.5 E	+.080
Penn.....	Philadelphia.....	5.5 W	6.3 W	6.8 W	7.4 W	8.0 W	+.083
	Altoona.....	3.1 W	3.8 W	4.5 W	5.1 W	5.6 W	+.067
P. R.....	San Juan.....	....	....	....	1.0 W	2.0 W	
R. I.....	Newport.....	10.3 W	10.8 W	11.3 W	11.9 W	12.4 W	+.100
S. C.....	Columbia.....	2.1 E	1.4 E	0.8 E	0.2 E	0.1 W	+.043
S. D.....	Huron.....	12.6 E	12.1 E	11.4 E	11.1 E	11.4 E	+.030
	Rapid City.....	16.3 E	15.8 E	15.3 E	15.1 E	15.4 E	+.042
Tenn.....	Chattanooga....	3.3 E	2.6 E	2.0 E	1.5 E	1.3 E	−.033
Tenn.....	Huntington.....	6.1 E	5.5 E	4.9 E	4.4 E	4.3 E	−.008
Texas.....	Houston.....	8.9 E	8.5 E	7.9 E	7.7 E	8.1 E	+.042
	San Antonio.....	9.6 E	9.3 E	8.9 E	8.7 E	9.1 E	+.050
	Pecos.....	11.0 E	10.8 E	10.4 E	10.3 E	10.7 E	+.060
	Floydada.....	11.2 E	10.9 E	10.4 E	10.3 E	10.7 E	+.052
Utah.....	Salt Lake City .	16.7 E	16.5 E	16.3 E	16.5 E	17.0 E	+.070
Vermont ..	Rutland.....	10.6 W	11.2 W	11.6 W	12.1 W	12.7 W	+.100
Va.....	Richmond.....	1.8 W	2.5 W	3.1 W	3.7 W	4.2 W	+.067
	Lynchburg.....	0.5 W	1.2 W	1.8 W	2.4 W	2.8 W	+.057
Wash.....	Wilson Creek....	21.9 E	21.9 E	22.1 E	22.4 E	22.9 E	+.075
Wash.....	Seattle.....	22.1 E	22.3 E	22.6 E	23.0 E	23.5 E	+.083
W. Va....	Charleston.....	0.2 W	0.9 W	1.5 W	2.1 W	2.6 W	+.057
Wis.....	Madison.....	7.2 E	6.4 E	5.6 E	5.0 E	4.9 E	−.017
Wyo.....	Douglas.....	16.0 E	15.8 E	15.4 E	15.3 E	15.7 E	+.053
	Green River....	17.0 E	16.9 E	16.6 E	16.6 E	17.0 E	+.060

LIGHT

PHOTOMETRIC STANDARDS

Value of Various Standards in International Candles

Standard Pentane Lamp, burning pentane..... .10.0 candles
Standard Hefner Lamp, burning amyl acetate.... 0.9 "
Standard Carcel Lamp, burning colza oil..... 9.6 "
Standard English Sperm Candle, about..... 1.0 "

The *Carcel unit* is the horizontal intensity of the carcel lamp, burning 42 grams of colza oil per hour. For a consumption between 38 and 46 grams per hour the intensity may be considered proportional to the consumption.

The *Hefner unit* is the horizontal intensity of the Hefner lamp burning amyl acetate, with a flame 4 cm. high. If the flame is l mm. high, the intensity $I = 1 + 0.027(l - 40)$.

STANDARD CANDLES

The horizontal intensity may be considered proportional to the rate of consumption of material if the variation is small.

	French.	English.	German.
Material.....	2 pts. stearic acid 1 pt. palmitic acid	Spermaceti	Paraffin
Temp. of fusion.	54° C.	44.4–46°.1 C.	55° C.
Wick (cotton)...	81 threads	54 to 63 threads	24 to 25 threads
Height of flame..	5.24 cm.	4.5 cm.	5 cm.
Rate of consumption of material	10 g. per hr.	7.78 g. per hr.	7.7 g. per hr.
Horizontal intensity in Internat. candles	1.34	1.05	1.11

MECHANICAL EQUIVALENT OF LIGHT

The luminous equivalent of radiation of maximum visibility,

One lumen = 0.001496 watts

One watt, radiation of maximum visibility ($\lambda = 0.556\mu$) = 668 lumens

MEAN HORIZONTAL CANDLE POWER OF VARIOUS LIGHT SOURCES

GIVEN IN INTERNATIONAL CANDLES.

(Lux, 1907.)

Source.	Total power consumed in watts.	Mean horizontal candle power.	Efficiency in watts per candle (spherical)
Acetylene flame	96	6.9	17.7
Electric arcs:			
Carbon, open air, continuous current	435	171	0.92
alternating current	181	98	2.27
Flaming arc, yellow	350	816	0.34
Mercury arc, uviol tube	199	393	0.64
quartz tube	691	3060	0.25
Incandescent electric, carbon filament	98	28.3	4.54
tantalum filament	44	31.1	1.83
tungsten filament	38	32.7	1.59
tungsten filament, gas filled	1000	1670	0.66
Incandescent gas mantle, vertical	717	96.3	8.9
inverted	571	96.3	7.7
Nernst lamp	181	108	2.12

PRIMARY COLOR SENSATIONS PRODUCED BY VARIOUS LIGHT SOURCES

The relative values of the excitation of the three primary sensations are given.

(Ives, 1911.)

Source.	Red.	Green.	Blue.
Black body at 5000° absolute	33	33	33
Blue sky	29	30	41
Clouded sky	35	34	31
Sun	38	37	25
Hefner lamp	54	40	6
Acetylene flame	49	40	11
Incandescent carbon filament	51	41	8
Tungsten filament	48	41	11
Nernst filament	49	40	11
Electric arc, carbon	41	36	23
Mercury arc	29	30	41
Flaming arc	52	37.5	10.5
Incandescent gas mantle, thorium with 0.25 part in 100 of cerium	42	41	17

INTRINSIC BRILLIANCY OF SURFACE INTENSITY OF LIGHT SOURCES

GIVEN IN INTERNATIONAL CANDLES PER SQUARE CENTIMETER.

Sources.	Surface intensity.	Observer.
Electric arc:		
current of 10 amperes	16000	Blondel, 1897
current of 25 amperes	19500	Blondel, 1897
current of 250 amperes	30000	Rey & Blondel, 1902
Flaming arc	4000	
Flames, candle	0.4–0.6	
petroleum lamp, round wick	3.3	Stockhausen, 1910
petroleum lamp, flat wick	.67	Stockhausen, 1910
gas, argand burner	1.14	Stockhausen, 1910
acetylene, flat flame	5.6	Stockhausen, 1910
Incandescent electric:		
filament of carbon (3.3 watts per candle)	75.	Blondel, 1911
filament of tungsten (1.2 watts per candle)	150.	Blondel, 1911
Nernst	350–470	Ives & Luckiesch, '11
Gas mantle	4.8–6.7	Ives & Luckiesch
Mercury arc	2.5	Ives & Luckiesch
Moon	0.4	Pickering, 1908
Star (Algol)	840000	Nordmann, 1910
Sun at zenith	160000	Palaz, 1893

WAVE LENGTHS OF VARIOUS RADIATIONS

	Microns
Cosmic rays	0.00000005
Gamma rays	0.000001–0.000140
X rays	0.000010–0.015000
Ultra-violet	0.0136–0.4000
Limit of solar spectrum in the ultra-violet, due to atmospheric absorption	0.292
Visible spectrum	0.4000–0.8000
Violet, representative, 0.410, limits	0.4000–0.422
Blue, representative, 0.470, limits	0.422–0.492
Green, representative, 0.520, limits	0.492–0.535
Maximum visual intensity	0.535
Yellow, representative, 0.580, limits	0.535–0.586
Orange, representative, 0.600, limits	0.586–0.647
Red, representative, 0.650, limits	0.647–0.800
Infra-red	0.800–420.000
Limit of solar spectrum	5.300
Hertzian waves	220. microns–20,000 meters

BRIGHTNESS OF TUNGSTEN

(*Forsythe 1922*)

Temperature° K	Brightness, candles per square centimeter	Per cent. change in candle-power for one per cent. change in temperature
1000	.000098	27.0
1200	.00585	21.6
1400	.1075	18.1
1600	.925	15.6
1800	5.21	13.7
2000	20.1	12.3
2200	61.7	11.2
2400	155.5	10.3
2600	343	9.5
2800	679	8.9
3000	1235	8.4
3200	2105	8.1
3400	3380	7.9
3600	5200	7.8

RELATIVE VISIBILITY

The visibility at wave length .556μ is taken as unity.

(*Hyde, Forsythe and Cady*)

Wave-length	Relative visibility	Wave-length	Relative visibility	Wave-length	Relative visibility
0.40μ	0.00009	0.52μ	0.698	0.64μ	0.154
.41	.0006$_2$	.53	.847	.65	.094
.42	.004$_1$	.54	.968	.66	.051
.43	.011$_5$	.55	.996	.67	.026
.44	.022	.56	.995	.68	.012$_5$
.45	.036	.57	.944	.69	.006$_2$
.46	.055	.58	.855	.70	.003$_1$
.47	.0087	.59	.735	.71	.0015
.48	.138	.60	.600	.72	.0007$_4$
.49	.216	.61	.464	.73	.0003$_6$
.50	.328	.62	.341	.74	.0001$_8$
.51	.515	.63	.238	.75	.00009
				.76	.00005

VARIATION IN THE SENSITIVENESS OF THE EYE WITH THE WAVE LENGTH

FOR LOW INTENSITIES

(König.)

Wave length...	.410	.430	.450	.470	.490	.510	.530	.550	.570	.590	.610
Mean sensitiveness.....	0.02	0.06	0.23	0.49	0.81	1.00	0.81	0.49	0.22	0.077	0.026

WAVE LENGTHS OF THE FRAUNHOFER LINES

SUN'S SPECTRUM

At 15° C. and 76 cm. pressure. Wave length in Ångström units (Fabry and Buisson system).

Line.	Due to	Wave length	Line.	Due to	Wave length
U	Fe	2947.9	*h*	H	4101.9
t	Fe	2994.4	*g*	Ca	4226.7
T	Fe	3020.7	*G*	Ca	4307.7
s	Fe	3047.6		Fe	4307.9
	Fe	3099.9	*G*	H	4340.5
S	Fe	3100.0	*F*	H	4861.4
	Fe, Mn	3100 3	b_4	Mg	5167.3
	Fe, Ti	3100.7	b_2	Mg	5172.7
R	Ca	3179.3	b_1	Mg	5183.6
Q	Fe	3286.8	*E*	Fe	5269.6
P	Ti	3361.2	D_2	Na	5890.0
O	Fe	3440.6	D_1	Na	5895.9
	Fe	3441.0	*C*	H	6562.8
N	Fe	3581.2	*B*	O	6867.2
M	Fe	3719.9	*A*	O	7593.8
L	Fe, C	3820.4	*Z*	.....	8228.5
K	Ca	3933.7	*Y*	.....	8990.0
H	Ca	3968.5			

WAVE LENGTHS FOR SPECTROSCOPE CALIBRATION

Source.	Wave length.	Source.	Wave length.
Potassium flame.....	0.7699μ	*E*, solar.....	0.5270μ
Potassium flame.....	0.7666	b_1, solar or magnesium flame	0.5184
B, solar.....	0.6867	b_2, solar or magnesium flame	0.5173
Lithium flame.....	0.6708	*F*, solar or hydrogen tube..	0.4867
C, solar or hydrogen tube..	0.6563	Strontium flame.....	0 4608
D_1, solar or sodium flame..	0.5896	*G*, solar or hydrogen tube...	0.4308
D_2 solar or sodium flame..	0.5893	H_1, solar.....	0.3969
Thallium flame.....	0.5351	H_2, solar.....	0.3934

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS

The following table gives the wave lengths of the principal lines of the emission spectra of elementary substances, produced by the arc, spark or Geissler tube.

Wave Lengths are stated in ångstroms and refer to air at a pressure of 1 atmosphere except in the Schumann region. 1 ångstrom (Å) = 10^{-8} cm. = 10^{-4} microns (μ) = 10^{-1} millimicrons (mμ) = 100$\mu\mu$.

Intensities of lines are indicated by the numbers 1 to 10, the latter, the higher intensity. For more complete tables the reader is referred to Kayser: *Handbuch der Spektroscopie.*

Characteristics of the lines are indicated by symbols following the intensity numbers, as shown below.

The **number of components** of an unresolved line is indicated by the subscripts: $_2$, $_3$, $_4$ attached to the intensity number.

Classes of spectra are indicated by the symbols I, II, III etc. referring to lines emitted by the neutral, ionized or doubly ionized atom. These symbols preceed the wave length.

Persistent lines are indicated by p. The most sensitive of the persistent lines by P. These symbols follow the wave length.

r, easily reversed
n, broad or nebulous
N, very broad and diffuse
<, broadened toward greater wave lengths
>, broadened toward shorter wave lengths
$_2$, $_3$, $_4$, etc. unresolved line of 2, 3 or 4 components
I, II, III etc. classes of spectra emitted by neutral, ionized or doubly ionized atom respectively
p, persistent lines
P, the most sensitive of the persistent lines.

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS

Aluminum

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.
III 695.82	..	3	I 2 210.05	2r	....	III 3 702.09	..	2n
III 696.23	..	2	I 2 258.0	2	....	III 3 713.10	..	3n
III 854.98	..	3	I 2 263.45	4r	2r	II 3 900.68	..	2
III 856.80	..	3	I 2 263.73	2	....	I 3 944.03 p	10r	8r
II 1 190.07	..	2	I 2 269.09	4r	2r	I 3 961.54 P	10r	8r
II 1 191.83	..	2	I 2 269.21	2r	....	II 4 226.81	..	6
II 1 211.93	..	1	I 2 312.4	..	1	III 4 479.97	..	5n
1 310.?	..	6	II 2 321.56	2	6	III 4 512.53	..	5n
1 319.?	..	6	I 2 367.06	8r	4r	III 4 529.18	..	6
III 1 384.	..	5	II 2 369.30	1	4	II 4 585.82	..	6
III 1 606.	..	8	I 2 372.06	3	3	II 4 663.05	..	10
III 1 612.	..	8	I 2 373.13	8r	4r	III 4 701.65	..	6
II 1 671. p	..	10	I 2 373.36	2r	2r	I 5 105.	?(2)	....
II 1 719.	..	9	I 2 378.43	3	1	III 5 150.86	..	5
II 1 721.	..	9	II 2 545.60	..	6	III 5 163.90	..	7
II 1 725.	..	10	II 2 568.00	10r	6r	I 5 557.05	2	....
II 1 750.	..	2	I 2 575.11	10r	6r	I 5 557.95	2	....
1 752.	..	3	I 2 575.44	3r	2	II 5 593.23	..	10
II 1 760.1	..	7	II 2 631.73	..	7n	III 5 696.45	..	5
II 1 761.9	..	7	I 2 652.48	10r	4r	III 5 722.65	..	6
II 1 763.9	..	10(2)	I 2 660.39	10r	5r	II 5 861.53	..	7
II 1 765.7	..	7	II 2 669.17	..	10	6 151.7	1n	....
II 1 767.6	..	9	III 2 762.81	..	9	6 176.	1n	....
1 777.	..	4	II 2 816.3	..	10n	II 6 231.76	..	7
1 792.	..	3	III 2 907.5	..	10	II 6 243.35	..	10
1 818.3	..	2	II 3 050.08	4	8	I 6 696.07	3	....
III 1 854.67 p	..	10	3 054.70	4	2	I 6 698.73	3	....
II 1 858.15 p	..	7	II 3 057.15	4	10	7 362.5	2<	....
II 1 862.48 p	..	10	3 059.93	2	1	7 466.	..	....
III 1 862.90 p	..	10	3 064.31	4	2	I 7 836.9	6<	....
II 1 930.3	..	2	3 066.16	4	2	I 8 774.5	5<	....
III 1 935.2	..	7	I 3 082.16 p	10r	8r	I 11 255.	..	....
II 1 989.8	..	8	I 3 092.72 p	10r	8r	I 13 125.	..	....
II 2 016.1	..	1	I 3 092.85 p	6r	4r	I 13 151.	..	....
II 2 094.8	..	5	II 3 443.65	..	6	I 16 720.	..	....
I 2 168.00	1r	1	II 3 587.06	..	10n(3)	I 16 752.	..	....
I 2 174.02	1r	1	III 3 601.62	..	7n	I 21 098.	..	....
I 2 199.57	1	....	III 3 612.35	..	7n	I 21 166.	..	....
I 2 204.63	2r	....	II 3 655.00	..	8(2)	I 39 108.	..	....

Antimony

456.	..	1	1 211.	..	10	1 926.6	..	5
691.	..	2	1 225.	..	10	2 023.9	..	4
723.	..	3	1 307.	..	10	2 039.7	..	5
805.	..	5	1 438.	..	10	2 054.0	..	6
861.	..	6	1 514.	..	10	2 068.4 p	4r	1
976.	..	10	1 566.3	..	8	I 2 175.9 p	5r	3r
981.	..	10	1 585.	..	8	2 179.25	4r	3r
1 012.	..	10	1 712.	..	6	2 306.5	5r	4
1 042.	..	10	1 725.	..	6	I 2 311.5 p	6r	10r
1 048.	..	10	1 731.	..	5	2 373.7	4r	3
1 162.	..	10	1 762.	..	10	2 383.64	3r	4
1 168.	..	10	1 783.	..	10	2 426.36	3r	3
1 171.	..	10	1 810.	..	5	I 2 445.55	3r	6
1 193.	..	10	1 867.	..	8	2 478.34	2	6
1 205.	..	10	1 870.6	..	10	I 2 528.54 p	6r	10r

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

Antimony (Continued)

	Wave length.	Arc.	Spark.		Wave length.	Arc.	Spark.		Wave length.	Arc.	Spark.
	2 590.29	..	10		3 473.9	..	10		6 806.3	6	1
I	2 598.08 p	10r	10r		3 498.5	..	10		7 844.4	4	....
	2 612.32	3r	8	I	3 504.5	3	10		7 924.6	6	....
	2 652.60	3r	8	I	3 637.8	9	6		9 520.	2	....
I	2 670.67	5r	5	I	3 722.8	8	5		9 951.	2	....
	2 682.77	4r	5	I	4 033.5	6	4		10 080.	4	....
	2 692.27	3r	3		4 195.1	..	8		10 263.	4	....
	2 718.90	3r	10		4 265.0	..	10		10 587.	5	....
	2 727.22	5r	8		4 352.2	..	10		10 678.	10	....
I	2 769.95	10r	10r		4 591.8	..	5		10 743.	5	....
	2 790.4	..	10		4 693.0	..	10		10 840.	5	....
	2 851.1	4	4		5 568.0	3	3		10 880.	3	....
I	2 877.92	10r	10r		5 632.0	4	....		11 013.	2	....
	2 913.3	..	5		5 639.7	2	5		11 082.	2	....
I	3 029.8	8r	10		5 730.4	4	....		11 109.	2	....
	3 040.7	..	10		6 005.0	6	3		11 190.	1	....
I	3 232.5 p	8r	10		6 079.6	6	1		11 268.	4	....
	3 241.2	..	10		6 129.9	6	3		11 864.	4	....
I	3 267.5 p	8r	10		6 611.4	3	2		12 118.	2	...
I	3 383.2	5	2		6 778.4	6	....				

Argon, Blue Spectrum

Wave length.	Geissler tube.	Wave length.	Geissler tube.	Wave length.	Geissler tube.
1 333.7	5	2 313.9	4	2 796.7	2
1 334.5	7	2 316.4	4	2 806.2	6
1 335.8	7	2 331.6	4	2 842.6	2
1 460.1	5	2 337.7	5	2 855.2	3
1 589.5	4	2 344.3	5	2 865.9	4
1 600.7	5	2 350.5	4	2 878.8	3
1 669.7	7	2 364.1	4	2 884.1	4
1 673.5	7	2 395.6	4	2 891.7	4
1 675.6	7	2 404.3	4	2 896.8	2
1 788.1	5	2 415.6	6	2 924.7	3
1 820.0	7	2 438.7	6	2 931.5	2
1 830.6	10	2 452.9	1	2 943.0	7
1 831.4	9	2 479.1	6	2 955.4	5
1 836.3	9	2 480.8	5	2 979.1	6
1 843.1	9	2 490.9	6	3 029.0	4
1 855.7	9	2 499.4	4	3 033.6	3
1 865.9	8	2 500.3	4	3 093.40	6
1 868.7	8	2 512.2	3	3 139.06	5
1 873.2	10	2 515.5	8	3 161.44	5
1 877.7	8	2 516.7	8	3 169.71	5
1 879.7	8	2 544.7	6	3 181.09	4
1 886.1	7	2 562.2	6	3 204.35	3
2 050.4	1	2 647.5	8	3 212.62	2
2 219.8	4	2 708.3	8	3 243.72	3
2 234.6	4	2 732.6	6	3 249.83	3
2 243.6	4	2 744.8	8	3 263.58	3
2 252.3	4	2 753.8	8	3 281.71	5
2 281.5	5	2 762.0	3	3 285.77	7
2 309.3	4	2 769.6	6	3 293.65	4

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

ARGON, BLUE SPECTRUM (Continued)

Wave length.	Geissler tube.	Wave length.	Geissler tube.	Wave length.	Geissler tube.
3 301.81	6	3 753.5	3	4 203.4	2
3 307.23	4	3 763.59	4	4 218.66	3
3 311.19	5	3 765.32	6	4 222.64	4
3 336.15	4	3 766.14	3	4 226.98	3
3 344.73	4	3 770.61	3	4 228.2	7
3 350.97	4	3 780.89	7	4 237.21	4
3 358.51	4	3 786.42	4	4 266.29	6
3 366.61	2	3 795.38	5	4 266.4	6
3 370.93	2	3 799.47	3	4 277.5	8
3 376.47	4	3 803.23	3	4 282.88	4
3 388.54	5	3 808.58	2	4 300.66	2
3 391.77	5	3 809.46	4	4 309.15	2
3 421.67	3	3 826.80	4	4 331.17	7
3 429.69	2	3 830.43	3	4 332.04	3
3 430.48	2	3 845.37	3	4 348.0	10
3 454.15	3	3 850.56	9	4 352.21	4
3 464.20	4	3 868.55	7	4 362.04	3
3 466.3	3	3 872.14	4	4 370.75	5
3 476.79	7	3 875.25	5	4 371.31	5
3 478.26	4	3 880.29	3	4 379.64	6
3 480.51	5	3 891.39	4	4 400.09	4
3 491.29	5	3 891.99	6	4 401.00	5
3 491.57	8	3 907.70	3	4 425.99	8
3 499.68	3	3 911.56	3	4 430.18	4
3 503.59	2	3 914.78	5	4 431.00	4
3 509.36	2	3 925.76	4	4 433.90	2
3 509.80	4	3 928.61	8	4 481.83	5
3 511.16	5	3 931.20	3	4 488.2	2
3 514.40	6	3 932.56	5	4 491.0	2
3 520.02	4	3 944.30	5	4 498.5	2
3 521.29	3	3 946.10	4	4 502.95	3
3 521.97	2	3 958.40	3	4 545.06	6
3 535.37	5	3 960.45	3	4 547.7	2
3 545.64	7	3 968.37	4	4 579.35	6
3 545.86	7	3 974.52	4	4 589.89	6
3 548.53	3	3 979.40	5	4 609.56	6
I 3 559.54	7	3 992.03	4	4 637.17	3
3 561.06	6	4 013.84	7	4 657.88	4
I 3 564.41	2	4 033.85	3	4 726.83	4
3 565.06	3	4 035.45	3	4 735.87	5
3 576.65	8	4 038.83	4	4 764.85	4
3 581.66	5	4 042.89	6	4 805.99	8
3 582.39	6	4 052.96	4	4 847.77	6
3 588.49	9	4 072.02	7	4 865.9	4
3 622.18	4	4 072.43	4	4 867.5	4
3 637.08	3	4 076.70	6	4 879.9	6
3 637.86	4	4 077.03	2	4 882.3	2
3 639.86	4	4 079.61	4	4 888.7	2
3 650.9	3	4 080.61	2	4 904.8	2
3 655.35	4	4 082.41	4	4 933.2	4
3 656.12	2	4 099.45	2	4 942.9	2
3 660.52	3	4 103.95	9	4 955.1	2
3 717.21	3	4 112.82	3	4 965.1	4
3 718.25	5	4 128.6	3	4 972.2	3
3 720.46	3	4 131.78	6	5 009.3	6
3 724.53	3	4 156.14	4	5 017.2	5
3 729.33	9	4 178.38	3	5 024.3	1
3 737.92	5	4 179.30	3	5 062.1	6

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

ARGON, BLUE SPECTRUM (Continued)

Wave length.	Geissler tube.	Wave length.	Geissler tube.	Wave length.	Geissler tube.
5 142.0	4	5 217.0	2	6 172.2	4
5 145.40	4	5 287.0	3	6 243.4	2
5 165.8	4	5 305.8	6	6 640.2	0
5 176.4	3	6 114.8	3		

ARGON, RED SPECTRUM

	2 516.2	4	I	4 158.59	9	5 506.4	2
	2 614.5	4	I	4 164.18	7	5 525.1	2
	2 802.1	3	I	4 181.88	7	5 558.8	5
	2 833.5	3	I	4 190.71	5	5 559.7	2
	3 873.4	3	I	4 191.03	8	5 572.6	4
	2 967.2	5	I	4 198.32	8	5 581.6	2
	2 968.3	2	I	4 200.68	9	5 597.7	2
	3 021.8	3		4 201.9	2	5 607.0	6
	3 034.6	3	I	4 251.18	5	5 618.1	2
	3 295.3	2		4 259.36	9	5 648.8	2
I	3 319.3	2		4 266.29	8	5 650.8	5
	3 325.49	2	I	4 272.17	8	5 659.2	3
	3 373.5	2	I	4 300.10	8	5 682.4	2
	3 392.8	2	I	4 333.56	7	5 691.7	1
I	3 393.8	3	I	4 335.29	6	5 739.7	3
I	3 461.06	3	I	4 345.17	7	5 772.3	2
I	3 554.31	4	I	4 363.78	3	5 802.2	1
	3 555.31	2		4 501.5	1	5 832.1	1
	3 556.00	2	I	4 510.73	8	5 860.4	3
I	3 563.2	3	I	4 522.33	4	5 882.7	3
I	3 564.3	2		4 596.10	5	5 888.7	4
I	3 567.68	4	I	4 528.45	5	5 900.5	1
I	3 572.27	2		4 702.32	4	5 912.1	5
I	3 599.3	1		4 768.4	1	5 916.6	2
I	3 606.53	5		4 888.1	1	5 927.1	2
I	3 632.65	4		4 894.8	1	2 928.5	4
I	3 634.46	4		5 049.	2	5 940.9	2
I	3 643.1	2		5 054.3	1	5 943.0	3
I	3 649.9	3		5 060.2	3	5 949.3	3
	3 659.5	2		5 063.0	1	5 964.5	2
	3 670.7	3		5 152.5	3	5 968.4	2
	3 678.31	5		5 162.4	4	5 971.7	3
	3 680.1	4		5 177.6	1	5 987.3	3
I	3 690.9	1		5 187.3	3	5 999.2	2
I	3 696.5	1		6 188.3	3	6 005.8	2
	3 770.4	3		5 221.6	3	6 013.6	3
I	3 775.4	1		5 252.9	3	6 025.4	3
I	3 781.33	3		5 254.4	2	6 032.13	6
I	3 834.65	5		5 373.6	2	6 043.2	6
I	3 866.14	1		5 410.6	2	6 052.6	4
I	3 894.64	3		5 421.6	4	6 059.4	5
I	3 899.90	2		5 440.1	2	6 064.7	3
I	3 947.55	4		5 442.1	1	6 067.7	1
I	3 948.98	7		5 443.3	2	6 090.8	3
I	4 032.96	2		5 451.7	5	6 098.7	4
I	4 044 42	8		5 457.8	2	6 101.1	2
	4 045.88	4		5 467.2	2	6 104.5	2
I	4 054.50	3		5 473.6	2	6 105.8	4
	4 152.7	3		5 495.9	6	6 113.4	2

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

ARGON, RED SPECTRUM (Continued)

Wave length.	Geissler tube.	Wave length.	Geissler tube.	Wave length.	Geissler tube.
6 119.5	2	6 660.7	3	I 7 503.87 p	4
6 121.7	2	6 664.1	3	I 7 514.65	4
6 127.4	3	I 6 677.28	5	I 7 635.11	6
6 145.4	4	6 684.4	1	I 7 723.76	5
6 155.1	3	6 698.9	3	I 7 948.18	5
6 165.1	3	6 719.2	2	I 8 006.16	8
6 170.1	3	6 752.83	5	I 8 014.79	3
6 172.9	4	6 756.4	1	I 8 103.69	3
6 212.4	4	6 786.3	1	I 8 115.31 p	10
6 215.9	4	6 871.29	4	I 8 264.52	5
6 248.5	3	6 888.8	1	8 405.	6
6 278.6	2	6 937.67	2	I 8 408.21	6
6 296.8	3	I 6 965.43 p	6	I 8 424.65	10
6 307.6	3	7 030.25	2	I 8 521.44	5
6 364.8	3	I 7 067.22 p	5	I 9 123.7	10
6 369.6	3	I 7 147.04	1	I 9 225.9	5
6 384.5	4	7 206.99	1	I 9 658.9	7
6 416.31	6	I 7 272.94	3	I 10 640.	12
6 431.6	3	7 311.6	1	I 11 590.	8
6 466.5	3	7 315.9	1	12 500.	30
6 481.0	2	7 353.32	1	13 505.	4
6 493.9	2	7 372.12	1	13 719.	4
6 513.7	1	I 7 383.98	5	.....	.....
6 604.9	3	7 435.5	1	.....	.....

ARSENIC

Wave length.	Arc.	Spark.	Geissler tube.	Wave length.	Arc.	Spark.	Geissler tube.
529.	...	1	.....	2 074.	...	12	.....
827.	...	5	.....	2 113.	2	3	.....
873.	...	8	.....	2 134.	2	2	.....
878.	...	8	.....	2 144.2	4	1	.....
926.	...	8	.....	2 165.5	4	2	.....
952.	...	8	.....	2 183.0	1	1	.....
956.	...	8	.....	2 192.1	...	2	.....
963.	...	10	.....	2 205.2	2	.....	.....
984.	...	10	.....	2 206.0	2	.....	.....
1 001.	...	10	.....	2 228.7	2	1	.....
1 009.	...	10	.....	2 271.39	4	1	.....
1 081.	...	50	.....	I 2 288.14 p	10r	3	.....
1 093.	...	20	.....	I 2 349.84 p	10r	6	4
1 106.	...	10	.....	2 369.67	4r	5	4
1 171.	...	15	.....	2 370.77	4r	5	4
1 208.	...	30	.....	I 2 381.20	4r	5	5
1 267.	...	40	.....	2 437.22	1	5	3
1 287.	...	10	.....	2 456.52	4r	7	5
1 700.2	...	10	.....	2 492.91	2	5	4
1 733.0	...	15	.....	2 602.9	...	2	6
1 742.9	...	20	.....	I 2 745.00	6r	5	7
1 890. p	...	4r	.....	I 2 780.23 p	8r	10	8
1 936. p	...	5	.....	2 830.4	...	4	8
1 972. p	...	4r	.....	I 2 860.46	4r	8	7
2 031.	...	10	.....	I 2 898.73	4r	6	6

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

Arsenic (Continued)

Wave length.	Arc.	Spark.	Geissler tube.	Wave length.	Arc.	Spark.	Geissler tube.
2 926.2	...	1	6	4 458.6	...	2	7
2 959.6	...	7	6	4 461.1	...	.....	8
I 2 990.99	2	4	5	4 466.4	...	1	7
3 003.8	...	2	6	4 474.4	...	4	8
I 3 032.84	4	8	6	4 494.4	...	3	7
I 3 075.32	2	5	5	4 515.9	...	.....	7
3 116.5	...	3	7	4 528.4	...	.....	7
I 3 119.6	4	7	5	4 539.8	...	3	8
3 126.9	...	.....	6	4 543.6	...	.....	7
3 180.6	...	.....	6	4 549.0	...	2	9
3 255.	...	2	6	4 552.2	...	2	7
3 513.0	...	.....	6	4 590.8	...	.. ..	7
3 551.6	...	.....	5	4 602.5	...	.....	7
3 671.7	...	.....	6	4 607.3	...	2	5
3 787.2	...	3	6	4 619.4	...	.....	7
3 842.9	...	4	7	4 629.9	...	.....	7
3 922.5	...	10	7	4 672.5	..	.....	7
3 931.1	...	2	7	4 707.6	...	.....	7
3 948.6	...	3	6	4 730.7	...	.....	8
4 006.2	...	3	6	4 787.1	...	1	6
4 037.0	...	6	6	4 799.5	...	1	6
4 062.6	...	.....	7	4 802.1	...	1	6
4 065.4	...	2	7	4 811.8	...	1	6
4 082.4	...	.....	7	4 888.6	...	2	8
4 157.5	...	.....	7	4 915.3	...	.....	7
4 190.2	...	2	7	4 985.4	...	5	9
4 197.5	...	3	7	5 105.5	...	8	8
4 207.8	...	2	7	5 107.6	...	8	8
4 221.0	...	.....	7	5 161.1	..	7	7
4 228.2	...	2	7	5 182.2	...	.....	7
4 243.1	...	.....	7	5 205.3	..	1	6
4 299.4	...	3	6	5 331.3	...	8	7
4 302.1	...	.....	8	5 496.9	...	5	6
4 315.7	...	1	7	5 497.8	...	10	7
4 324.0	...	.....	7	5 558.1	..	10	8
4 336.7	...	5	7	5 620.6	...	1	10
4 352.1	...	5	7	5 651.3	...	10	10
4 352.9	...	.....	8	5 657.0	...	1	8
4 371.	...	5	7	5 684.8	...	1	7
4 412.0	...	.....	7	5 731.8	...	1	6
4 413.5	...	.....	7	5 837.9	...	.....	6
4 420.9	...	.....	7	6 023.	...	6	.....
4 427.2	...	.....	7	6 110.	...	6	.....
4 431.6	...	4	8	6 170.	...	6	.....

Barium

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.
1 331.	..	2	II 1 869.	..	5	II 2 634.80	5	8<
1 415.	..	3	II 2 304.22	6r	8r	II 2 647.29	4	4
1 504.	..	4	II 2 335.25	6r	10r	I 2 702.65	6<	2
1 554.	..	3	II 2 347.58	5	7	II 2 771.4	2	3<
1 674.	..	4	II 2 528.51	..	6<	I 2 785.26	6<	....
II 1 694.	..	8	I 2 596.68	6<	....	I 3 071.60	8r	6r

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

Barium (Continued)

	Wave length.	Arc.	Spark.		Wave length.	Arc.	Spark.		Wave length.	Arc.	Spark.
I	3 262.4	3r	....		5 680.17	5	1		9 370.1	3	....
I	3 356.9	6<	....	I	5 777.7 p	10r	5		9 527.	10	....
I	3 377.0	8	....		5 800.34	7	2		9 611.	10	....
I	3 377.4				5 805.71	5r	2		9 713.	2	....
I	3 420.3			I	5 826.30	7r	4	I	9 832	7	....
I	3 421.0	10	....	II	5 853.7	8r	5		10 002	3	....
I	3 421.5			I	5 907.6	6	2	II	10 034.	6	....
I	3 501.12	8r	2	I	5 971.71	10	3	I	10 189.	1	....
I	3 525.0	6<	....	I	5 997.10	7r	3		10 234.	6	....
I	3 544.7	6<	....	I	6 019.49	7r	3	I	10 273.	5	....
I	3 547.7	4n	....	I	6 063.16	8r	4	I	10 326.	..	....
I	3 579.7	6<	2	I	6 110.80	8r	5		10 474.	6	....
	3 630.65	8<	2	II	6 141.74	10r	10r	II	10 651.	8	....
	3 889.32	5	2	I	6 341.70	7r	3		10 692.	2	....
II	3 891.78	8<	8r	I	6 450.85	7	3		11 016.	4	....
	3 892.65	5			6 482.93	7r	3		11 116.	2	....
I	3 909.92	6<	6<	II	6 496.91	10r	10r	I	11 304.	2	....
I	3 935.72	7<	6<	I	6 498.77	8r	4		11 608.	2	....
I	3 937.88	5	3	I	6 527.32	8r	3		11 886.	5	....
I	3 993.40	8r	6	I	6 595.35	7r	3		11 978.	2	....
II	4 130.68	8r	10r	I	6 675.29	6r	2	II	12 084.	5	....
	4 132.44	5	3	I	6 693.86	6r	2		12 554.	3	....
II	4 166.04	5<	10<		6 865.69	5	....		12 815.	1	....
I	4 283.12	8	8	I	7 059.96	8r	....		13 057.	1	....
I	4 323.00	4>	1	II	7 120.30	6	....	I	13 207.	4	....
I	4 332.91	4>	1	I	7 195.26	6	....		13 811.	4	....
	4 350.38	8	5		7 228.82	5	....		13 957.	2	....
	4 402.55	8	6		7 280.31	8r	....		14 078.	4	....
I	4 431.91	7	6	I	7 392.44	6	....		14 160.	3	....
I	4 488.97	7>	2		7 417.55	4	....		14 211.	3	....
I	4 493.64	5>	2		7 459.7	5	....		14 325.	3	....
	4 505.94	8	5		7 488.10	5	....	I	15 000.	4	....
	4 523.25	8<	3		7 642.9	5	....		17 065.	1	....
II	4 524.95	8	10<		7 672.10	7	....		17 182.	1	....
II	4 554.04 P	10r	10r		7 780.50	8	....		18 204.	2	....
	4 573.88	6r	4		7 839.58	5	....		19 075.	2	....
	4 579.66	8r	8	I	7 905.77	7	....		19 988.	3	....
	4 599.75	6r	2	I	7 911.35	6	..	I	20 712.	4	....
I	4 619.98	5<	1		8 120.5	3	....	I	21 477.	2	....
I	4 628.83	5>	1		8 147.8	2	....		22 221.	2	....
I	4 673.61	7>	2		8 210.32	10	....		22 313.	2	....
	4 691.63	7r	4		8 559.91	10	....		23 255.	3	....
I	4 700.45	6<	1		8 567.6	3	....	I	25 516.	5	....
I	4 726.46	8<	5		8 582.1	4	....		26 221.	2	....
II	4 899.96	8	10		8 654.03	4	....		27 751.	3	....
I	4 902.88	4<	....	I	8 799.7	2n	....	I	29 224.	5	....
II	4 934.10 p	10r	10r		8 860.96	4	....		29 791.	4	....
I	5 424.63 p	7<	3		8 915.00	4	....		30 469.	2	....
I	5 519.11 p	8r	5		9 189.4	2	....	I	30 687.	2	....
I	5 535.53 P	10r	6		9 219.7	2	....	I	30 934.	3	....

Beryllium

II	1 036.32	..	3	II	1 776.34	..	8	I	2 351.50	6	....
II	1 512.30	..	8	I	2 056.71	4	....	I	2 494.53	7	3
II	1 512.45	..	10	I	2 175.72	10	....	I	2 494.58	7	3
II	1 776.12	..	6		2 348.62 P	8r	3	I	2 494.72	7	3

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

Beryllium (Continued)

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark
I 2 651.	10	10(5)	II 4 674.55	..	8	15 393.	6	....
II 3 047.86	..	4	II 5 274.28	..	4	15 400.		
II 3 131.32	9	10	10 283.	5	....	15 951.	..	....
3 131.97	9	5	10 674.	4	....	16 794.	2	....
II 3 198.01	..	4	12 141.	7	....	17 571.	2	....
II 3 275.57	..	5	12 329.	4	....	21 560.	3	....
I 3 321.97	8	2	12 355.	6	....	21 897.	2(2)	....
I 3 322.04	8	2	13 227.	6	....	22 239.	2	....
I 3 322.30	8	2	14 904.	3	....	23 097.	6	....
II 4 362.21	..	7	15 006.	3	....	23 110.		
4 572.69	8	1	15 013.					

Bismuth

670.	..	1	2 627.93	8r	4	5 742.55	6	....
791.	..	2	2 696.76	6r(2)	4r	5 861.14	..	4
967.	..	3	2 730.50	4r(2)	2r	6 128.1	..	4
1 045.	..	10	2 780.52 p	7r	4	6 134.85	5	1
1 051.	..	10	2 809.63 p	8r	2	6 475.5	3	....
1 306.	..	10	2 897.98 p	10r	5r	6 476.2	3	....
1 317.	..	15	2 938.31 p	10r	8r	6 497.5	..	4
1 346.	..	10	2 989.04 p	9r	5r	6 600.1	..	7
1 533.7	5	3	2 993.34	9r	4	6 809.1	..	7
1 776.7	3	4	3 024.64	8r	4r	6 991.1	4	....
1 787.1	3	4	3 067.73 P	9r	6r	7 036.2	2	....
1 791.7	4	4	3 076.67	3	2	7 335.0	1	....
1 823.5	3	5	3 397.21	5r	2	7 441.3	1	....
1 902.5	..	1	3 405.23	2r	1	7 502.3	2	....
1 959.6	..	3	3 510.85	6r	5	7 838.7	3	....
1 973.2	..	3	3 596.11	3r	4	7 840.3	2	....
2 061.7 p	8r	3	3 695.53	..	8	8 210.8	10	....
2 110.3	8r	2	3 792.9	..	8	8 501.8	1	....
2 113.8	3	....	3 887.94	2	1	8 544.5	2	....
2 133.6	7r	....	3 888.22	2	1	8 579.7	1	....
2 134.4	8r	1	4 079.22	..	10	8 627.9	1	....
2 143.6	..	2	4 121.52	6	4	I 8 754.9	2	....
2 144.4	..	2	4 121.85	6	4	8 761.5	3	....
2 152.9	7r	....	4 259.64	..	10	8 907.8	2	....
2 153.5	4r	....	4 302.13	..	10	9 058.6	2	....
2 156.9	4r	....	4 308.20	4	2	9 342.6	4	....
2 164.1	4r	....	4 308.56	4	2	9 657.2	10	....
2 177.3	6r	1	4 328.6	..	3	9 829.	2	....
2 189.59	6r	....	4 340.6	..	4	10 106.	2	....
2 203.1	4n	1	4 561.15	..	8	10 302.	2	....
2 214.1	3	1	4 722.2	10	5	10 540.	1	....
2 228.25	6r	2r	4 722.5	10	8	11 073.	1	....
2 230.62	8r	4r	4 722.7	8	8	11 556.	1	....
2 276.57 p	5r	2	4 729.9	..	3	11 711.	10	....
2 309.3	4N	....	4 733.8	2<	....	11 995.	1	....
2 328.2	2n	....	4 797.5	..	3	12 167.	4	....
2 400.89	8r	7	5 124.4	..	4	12 691.	3	....
2 430.5	2n	....	5 144.50	..	6	14 332.	3	....
2 489.4	5N	1	5 209.28	..	10	25 554.	1	....
2 515.68	6r	1	5 552.24	8	3			
2 524.52	7r	2	5 599.41	3	....			

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

Boron

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.
III 677.01	..	5	I 1 825.87	..	1	I 2 089.6	..	2
III 677.16			I 1 826.41			2 266.3	..	2
III 758.47	..	3	III 2 066.4	..	2	2 266.9	..	2
III 758.68			III 2 067.9			I 2 496.78 p	9r	9r
II 1 624.4	..	8(5)	I 2 088.8	..	1	I 2 497.73 P	10r	10r
						II 3 451.2 p	..	10

Bromine

Wave length.	Spark.	Geissler tube.	Wave length.	Spark.	Geissler tube.	Wave length.	Spark.	Geissler tube.
1 251.8	....	4	3 929.57	....	6	4 742.70	3	8
1 384.6	....	8	3 935.16	....	6	4 766.07	2	5
1 488.6	....	8	3 939.70	2	5	4 767.1	2	8
1 531.9	....	7	3 950.60	1	7	4 776.43	2	7
1 540.8 p	....	6	3 955.35	....	8	4 780.33	....	6
1 575.0	....	9	3 968.65	....	5	4 785.48 p	10	10
1 576.5	....	6	3 980.01	....	5	4 816.72 p	8	8
1 582.4	....	8	3 980.43	....	10	4 848.80	1	6
1 633.6 p	....	10	3 986.53	1	8	4 928.7	1	5
2 386.8	3	.....	4 007.30	....	5	4 930.6	1	5
2 389.8	3	.....	4 008.78	....	6	4 979.77	....	4
2 522.	4	.....	4 024.04	....	5	5 054.7	....	4
2 541.	4	.....	4 135.64	....	5	5 164.4	....	5
2 557.	4	.....	4 140.22	1	6	5 182.4	3	7
2 594.	3	.....	4 175.76	....	5	5 183.9	....	4
2 660.	3	.....	4 179.62	1	8	5 238.3	2	8
2 872.	3	.....	4 193.45	1	6	5 272.7	....	4
2 892.	3	.....	4 223.85	....	6	5 304.1	....	7
2 926.	5	.....	4 236.85	....	6	5 332.0	....	10
2 968.	4	.....	4 291.38	2	6	5 396.5	....	5
3 020.8	4	.....	4 365.58	4	8	5 422.8	....	7
3 074.	4	.....	4 425.13	....	5	5 425.0	....	5
3 168.	3	.....	4 441.74	....	8	5 435.1	....	5
3 282.1	3	.....	4 472.64	....	8	5 466.2	....	5
3 333.0	5	.....	4 477.78	....	10	5 488.8	....	6
3 396.9	4	.....	4 490.48	....	5	5 490.4	....	7
3 417.	5	.....	4 513.47	1	5	5 536.3	....	4
3 506.5	5	.....	4 525.6	....	8	5 589.9	....	8
3 517.4	5	.....	4 529.80	....	5	5 600.7	....	4
3 540.1	8	.....	4 538.75	1	5	5 657.6	....	4
3 562.4	10	.....	4 542.93	2	8	5 711.0	....	4
3 693.5	3	.....	4 575.77	....	6	5 719.0	....	4
3 794.0	3	4	4 601.4	....	5	5 830.8	....	7
3 834.71	....	6	4 614.6	....	6	5 852.2	....	5
3 857.21	....	6	4 622.7	3	8	5 940.6	....	4
3 871.23	....	6	4 652.00	1	6	6 118.7	....	4
3 891.64	1	8	4 672.58	1	6	6 123.3	....	3
3 914.26	1	10	4 678.70	8	8	6 149.7	....	10
3 919.6	....	6	4 693.30	5	3	6 350.8	....	10
3 920.68	....	6	4 704.83 p	10	10	6 560.0	....	4
3 923.36	....	6	4 719.76	3	8	6 631.8	....	5
3 924.09	2	8	4 735.47	....	5	6 682.	....	2

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

Cadmium

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.
396.	..	1	I 2 836.92	8r	6N	I 5 085.82	10r	10
847.	..	10	I 2 868.3	6<	3<	I 5 297.7	3	....
1 369.	..	20	I 2 880.78	8r	6	II 5 337.49	3	25
1 397.	..	20	I 2 881.24	4r	3N	5 338.5	..	10
1 462.	..	20	I 2 980.62	8r	6	I 5 339.	2	....
1 466.	..	8	I 3 080.83	8<	3<	5 378.	3	....
1 472.	..	8	3 095.5	..	5<	II 5 378.12	..	10
1 514.	..	20	3 129.23	..	5n	II 5 381.82	..	10
1 628.7	..	6	I 3 133.17	2<	5<	5 497.	..	10n
1 707.5	..	8	3 185.53	..	5	I 5 598.8	3	....
1 747.9	..	6	II 3 250.29	..	25	I 5 604.7	2	....
1 768.8	..	6	I 3 252.53	8<	6n	5 637.3	5	....
1 773.1	..	6	I 3 261.05	10r	7	I 6 031.4	3	....
1 844.5	..	10	3 298.97	4	4r	I 6 099.1	5	....
1 853.0	..	15	I 3 403.65 p	10r	10	I 6 111.5	3	....
1 873.6	..	15	II 3 417.40	..	10	I 6 116.12	3	1
1 900.7	..	6	I 3 466.20 p	10r	8r	I 6 325.1	5	1
1 921.8	..	2	I 3 467.66	8r	10	I 6 329.94	5	....
1 939.	..	2	II 3 495.36	..	15	II 6 359.93	..	10
I 1 942.	..	2	II 3 535.67	..	20	I 6 438.47	10	10r
1 995.	..	3	I 3 610.51 p	10r	10r	II 6 464.98	..	10
2 004.2	..	5	I 3 612.88	8r	9	II 6 725.83	..	15
2 055.3	..	3	I 3 614.4	7	7	I 6 777.7	2n	....
2 062.0	..	5	I 3 729.06	4r	....	I 7 346.0	1n	....
II 2 144.39 P	4r	6r	3 852.1	..	3	I 7 382.3	2n	....
II 2 194.62	1	4r	3 940.3	..	5	I 7 399.	5	....
2 239.86	6r	3	3 976.6	..	5	I 8 200.1	1n	....
II 2 265.03 p	4r	10r	3 977.3	..	5	I 10 394.6	10	....
2 267.47	4r	2	3 988.2	..	4	I 11 268.	4	....
I 2 288.03 P	10r	10r	II 4 029.08	..	10	I 11 630.	2	....
2 306.63	4r	3	4 057.5	..	5	I 13 979.	10	....
II 2 312.88	4	10r	4 094.8	..	4	I 14 327.	10	....
II 2 321.15	1	7	4 127.0	..	4	I 14 354.	8	....
2 329.27	8r	6	II 4 134.78	..	15	I 14 473.	8	....
2 469.76	..	4	4 191.6	..	4	I 14 849.	2	....
I 2 553.6	4<	....	4 216.9	..	6	I 15 154.	10	....
II 2 573.04	4	10	4 245.6	..	4	15 258.	7	....
I 2 639.50	6r	1n	II 4 412.31		10	I 15 711.	7	....
I 2 677.6	8(2)	3n	4 415.68	1	6	I 16 402.	2	....
I 2 712.6	6<	1n	I 4 678.15	10	10	I 16 432.	6	....
II 2 748.58	..	10	I 4 799.91	10r	10	I 16 482.	6	....
I 2 763.9	6r	3N	II 4 881.73	..	10	I 39 086.	..	....

Calcium

404.	..	6	1 562.	..	4	II 2 208.7	3	3
410.	..	6	1 667.	..	5	I 2 275.5	1	4r
537.	..	5	II 1 807.8	..	7	I 2 398.58	8r	1r
655.	..	6	II 1 815.0	..	8	2 493.00	7	....
669.	..	6	II 1 838.	..	9(2)	2 899.78	9	....
688.	..	5	II 1 840.2	..	10	2 924.33	8	....
718.	..	6	II 1 843.7	..	6	I 2 994.95	3	2
832.	..	10	II 1 851.3	..	7	I 2 997.31	3	2
840.	..	6	2 035.	4	....	I 3 000.87	4	2
902.	..	10	2 040.	4	....	I 3 006.85	4	4
II 1 434.	..	6	II 2 103.2	2	3	I 3 009.21	2	2
II 1 553.	..	7	II 2 112.7	2	3	3 119.66	..	8
II 1 555.	..	8(2)	II 2 197.8	3	3	II 3 158.87	8	10r

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

Calcium (Continued)

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.
II 3 179.34	6	10r	I 4 455.88 p	8r	8	6 449.82	5	3
II 3 181.3	4	10	I 4 456.62 p	4	5	6 455.57	3	2
I 3 215.1	3>	....	4 499.90	..	10	I 6 462.57	6r	6
I 3 225.8	4<	....	I 4 526.98	6	5	I 6 471.68	5	5
I 3 286.1	5	....	I 4 578.57	8	5	I 6 493.76	8	5
I 3 344.49	5>	....	I 4 581.45	8	6	I 6 499.64	5	4
I 3 350.19	6>	1	I 4 585.84	6	....	I 6 572.75	2	1
I 3 361.91	6>	1	I 4 585.91	2	8	I 6 717.7	8	2
I 3 468.48	4<	....	I 4 685.2	4>	1	7 148.18	10	....
I 3 474.78	4<	....	I 4 878.17	10<	8<	7 202.18	8	....
I 3 487.61	6<	1	I 5 141.65	8<	3	I 7 326.12	8	....
I 3 624.10	6	1	I 5 188.84	6	5	7 610.	6<	....
I 3 630.73	6	1	I 5 260.39	4	3	II 8 498.0	8	....
I 3 630.96	5	1	5 261.70	6	5	II 8 542.1	10	..
I 3 644.39	10	4	5 262.23	6	5	II 8 662.1	9	....
I 3 644.76	5	....	I 5 264.23	6	5	9 251.	3	....
II 3 706.03	6	8<	5 265.55	8	8	9 547.	7	....
II 3 736.91	6	10r	I 5 270.27	10	10	9 695.	7	....
I 3 875.7	3	....	5 349.46	10	5	I 10 345.	10	....
II 3 933.67 P	10r	10r	I 5 512.93	8	2	I 12 822.	5(2)	....
I 3 948.91	4<	1	5 581.96	8	4	13 038.	3	....
I 3 957.07	6<	2	5 588.74	10	10	I 16 145.	2	....
II 3 968.47 P	10r	10r	5 590.10	10	6	I 16 162.	2	....
I 3 973.7	6<	3<	I 5 594.47	8	6	I 16 200.	3	....
I 4 098.6	4<	2<	5 598.46	10	8	16 433.	1	....
I 4 226.73	10r	10r	I 5 601.26	8	4	I 19 311.	4	....
I 4 240.44	4	2	5 602.84	8	5	I 19 453.	5	....
I 4 283.00	8r	8r	5 857.49	10	10	I 19 507.	3	....
I 4 289.36	8r	8r	5 867.62	4<	....	I 19 777.	6	....
I 4 298.99	6	8r	I 6 102.73	8r	8r	19 817.	1	....
I 4 302.53	10r	10r	I 6 122.24	10r	10r	I 19 857.	4	....
I 4 307.74	8r	8r	I 6 161.32	5	2	I 19 865.	4	....
I 4 318.65	8r	8r	I 6 162.20	10r	8r	I 19 918.	1	....
I 4 355.2	6n	2	I 6 163.80	4	2	I 19 936.	3	....
I 4 425.44	10r	10	I 6 166.49	4	2	I 19 947.	1	....
I 4 434.96	10r	10r	I 6 169.08	4	3	I 22 610.	1	....
I 4 435.68	8r	8	I 6 169.60	7	3	I 22 625.	3	....
I 4 454.78 p	10r	10r	I 6 439.06	10r	8	I 22 656.	4	....

Caesium

1 884.0	..	6	2 544.	..	10	2 977.	..	6
1 889.2	..	6	2 573.	..	8	3 067.	..	10
1 935.2	..	8	2 597.	..	10	3 149.6	..	8
2 035.7	..	8	2 600.	..	8	3 152.7	..	6
2 080.6	..	8	2 631.	..	10	3 211.	..	6
2 089.2	..	8	2 700.	..	8	3 268.3	..	10
2 102.4	..	10	2 707.	..	10	3 300.	..	8
2 132.4	..	10	2 776.	..	10	3 316.	..	8
2 142.2	..	10	2 811.	..	6	3 341.	..	8
2 147.5	..	10	2 838.	..	8	3 350.	..	8
2 180.2	..	9	2 845.	..	10	3 411.3	..	9
2 206.3	..	10	2 859.	..	10	3 559.8	..	5
2 221.3	..	10	2 887.	..	10	3 597.4	..	6
2 268.3	..	10	2 894.	..	8	3 608.3	..	5
2 274.5	..	10	2 931.1	..	10	3 661.4	..	6
2 495.	..	8	2 938.	..	8	3 699.5	..	5
2 526.	..	10	2 963.	..	8	II 3 785.4	..	5

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

Caesium (Continued)

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark
II 3 805.1	..	6	II 4 646.5	..	5	I 7 280.0	5<	1
3 876.2	1	....	4 763.6	..	5	I 7 609.0	8	....
3 888.4	2	2	II 4 830.2	..	6	I 7 944.0	8	....
II 3 897.0	..	7	4 870.0	..	6	I 8 016.2	5<	....
II 3 925.6	..	6	II 4 952.8	..	6	8 016.9		
II 3 965.2	..	6	II 4 972.6	..	5	I 8 079.1	10<	....
3 974.2	..	6	II 5 043.8	..	6	I 8 079.8		
4 006.5	..	6	II 5 096.6	..	4	I 8 521.2 P	10r	....
4 039.8	..	9	II 5 227.0	..	8	I 8 761.3	4	....
4 068.0	..	6	II 5 249.4	..	6	I 8 944.P	6r	....
4 068.8	..	6	5 274.0	..	4	I 9 172.2	4	....
4 158.6	..	4	II 5 371.0	..	6	I 9 209.	6	....
4 213.3	..	6	5 402.8	..	4	I 10 026.	10	....
4 232.19	..	6	II 5 419.7	..	5	I 10 124.	10	....
4 264.68	..	10	II 5 563.0	..	4	I 13 589.	8	....
II 4 277.1	..	9	II 5 831.2	..	5	I 13 605.	..	....
II 4 288.4	..	7	5 925.7	..	5	I 14 695.	10	....
4 300.6	..	6	6 010.4	4	2	I 29 317.	8	....
II 4 373.0	..	6	II 6 128.6	..	4	I 30 103.	6	....
II 4 384.4	..	5	6 213.0	8	2	I 30 963.	4	....
4 405.3	..	7	6 217.5	3	1	I 34 893.	7	....
II 4 435.7	..	4	6 354.5	4	1	I 36 128.	2	....
4 501.5	..	7	6 562.8	..	5	I 39 180.	1	....
II 4 526.7	..	7	I 6 586.5	10	1	I 42 202.	4	....
II 4 538.9	..	6	I 6 587.1	5<	....	I 68 070.	2	....
I 4 555.5 p	10r	4	I 6 723.3	10r	3	69 310.	2	....
I 4 593.18 p	10r	3	II 6 955.5	..	4	71 110.	1	....
II 4 603.8	10	10	I 6 973.3	10r	3	I 71 930.	1	....
4 616.1	..	4	I 6 983.4	6	1	74 250.	1	....
4 623.1	..	4	I 7 228.6	5<	1			

Carbon

Wave length.	Arc.	Spark.	Geissler tube.	Wave length.	Arc.	Spark.	Geissler tube.
313.	..	1	.....	IV 1 550.9	..	3	.....
372.	..	1	.....	I 1 561.3	5	5	5
III 459.7	..	6	.....	1 657.	6	6(4)	.....
II 533.9	..	1	.....	III 1 930.98	5	7(2)	.....
III 538.4	..	7	.....	III 2 297.59	2	10	.....
II 543.4	..	2	.....	1 2 478.3 P	10	10	10
II 560.5	..	2	.....	II 2 746.50	..	....	4n
574.4	..	6	.....	II 2 747.31	..	....	6n
II 594.9	4	5	.....	II 2 836.71	..	....	10
II 636.2	..	2	.....	II 2 837.60	..	....	8
651.	2	6(2)	.....	II 2 992.63	..	....	4
II 687.1	8	7	8	II 3 919.06	..	....	6
II 858.2	8	8	8	II 3 920.77	..	....	8
III? 904.	4	10(4)	.....	II 4 267.02 p	..	....	8n
III 977.02	..	12	.....	II 4 267.27 p	..	....	10n
I 1 010.1	9	10	.....	III 4 648.70	..	3	.....
II 1 036.2	..	10	5	III 4 651.46	..	2	.....
II 1 036.8	..		5	III 4 652.68	..	7	.....
1 176.	10	15(5)	.....	II 6 578.03	..	....	10
1 323.7	7	7	.....	II 6 582.85	..	....	8
1 329.1	8	4	.....	II 7 231.12	..	....	6n
1 329.6	8			II 7 236.19	..	....	8n
1 334.5 p	10	10	.....				
1 335.7 p	10						

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

Cerium

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.
399.	..	1	4 083.24	10	5	5 655.14	5	1
741.	..	5	4 106.89	5r	3	5 669.96	5	1
830.	..	20	4 133.82	10	10	5 677.74	4	1
1 332.	..	20	4 137.64	9	10	5 696.99	5	1
1 373.	..	20	4 149.94	10r	10	5 699.22	5	1
2 651.02	4	1	4 152.01	8	10	5 719.04	5	....
2 696.06	4	....	4 165.61 p	9	10	5 725.84	4	....
2 791.42	4	....	4 186.60 p	10	10	5 743.54	5	....
2 833.30	4	....	4 222.62	10	5<	5 768.94	4	1
2 896.75	4	....	4 248.67	8	6	5 773.12	4	....
2 976.90	4	1	4 255.79	8	3	5 788.15	4	....
3 017.18	4	1	4 289.94	9	6	5 804.42	4	....
3 051.98	5	1	4 296.68	9	8	5 812.9	5	....
3 063.00	6	2	4 306.73	8	4	5 838.12	4	1
3 103.38	6	1	4 320.73	8	3	5 862.49	4	....
3 146.40	6	1	4 337.76	9	4	5 871.58	3	....
3 171.63	6r	1	4 349.79	8	4	5 910.00	5r	....
3 194.83	7	1	4 375.18	8	3	5 928.34	4	....
3 201.72	7	1	4 382.17	8	5	5 934.40	4	....
3 221.17	7	1	4 391.66	8	8	5 940.86	4	1
3 234.17	7	1	4 396.58	3r	2	5 975.87	4	....
3 272.25	7	2	4 418.78	7	5	6 013.41	5	....
3 285.23	6	1	4 449.33	9	4	6 024.18	5	....
3 304.84	7	1	4 460.21	10	10	6 043.39	5	2
3 344.76	7	2	4 471.24	10	5	6 057.99	3	....
3 366.56	7	1	4 509.18	4r	3	6 069.48	3	....
3 377.13	7	2	4 527.35	10	5	6 098.35	4	1
3 426.20	8	1	4 528.47	10	5	6 123.66	4	....
3 442.38	7	1	4 539.74	10	5	6 186.16	3	....
3 476.84	6	2	4 562.35	10	10	6 209.00	3	....
3 485.06	8	2	4 572.28	10	10	6 228.98	4	1
3 488.55	7	1	4 593.93	10	10	6 232.47	3	1
3 517.38	7	2	4 606.41	4	5	6 272.05	4	2
3 539.08	7	2	4 628.15	10	10	6 295.58	3	....
3 560.82	8	4<	4 654.28	4	2	6 300.22	3	....
3 577.45	8	4<	4 684.61	4	3	6 310.03	3	....
3 613.70	10r	2	4 714.01	4	3	6 343.98	4	1
3 623.84	7	3	4 725.09	4	2	6 371.13	4	....
3 655.85	10	3	4 737.24	4	3	6 393.06	3	1
3 667.97	9	3	4 773.93	4	3	6 458.06	3	....
3 679.42	6	2	4 882.44	4	3	6 466.89	3	....
3 709.29	8	3<	4 893.93	3	2	6 467.40	3	....
3 716.36	9	3	4 971.50	4	2	6 473.69	3	....
3 764.12	8	3<	5 022.85	4	1	6 513.63	3	....
3 786.63	8	3	5 044.02	4	1	6 555.65	3	....
3 801.53	10	8	5 079.68	5	2	6 606.87	3	....
3 853.16	8	2	5 117.14	4	1	6 628.90	3	....
3 875.04	6r	2	5 187.44	6	2	6 652.75	3	....
3 878.37	9	2	5 191.63	5	1	6 665.65	3	....
3 890.00	8	3<	5 211.91	4	....	6 700.67	3	....
3 942.75	10	5	5 274.23	5	3	6 704.40	3	....
3 952.58	9r	8<	5 330.53	5	2	6 774.27	2	....
3 956.29	9	3	5 393.39	7	3	6 898.49	2	....
3 992.39	9	3	5 409.23	6	2	6 899.07	2	....
3 993.83	9	4	5 472.27	5	3	6 924.80	3	....
3 999.25	10	6	5 512.06	8	3	6 986.00	2	....
4 012.40 p	10	10	5 556.27	4	1	6 999.87	2	....
4 040.76 p	9	8	5 601.28	5	1	7 030.98	2	....
4 073.49	9	4	5 614.73	3	....	7 061.69	3	....

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

CERIUM (Continued)

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.
7 086.31	3	....	5 860.54	2	....	8 355.32	2	....
7 150.21	2	....	8 002.66	2	....	8 363.82	2	....
7 238.38	2	....	8 025.59	2	....	8 371.90	2	....
7 252.72	3	....	8 171.32	2	....	8 396.20	2	....
7 329.92	2	....	8 234.12	3n	....	8 495.64	3	....
7 397.78	2	....	8 245.10	2	....	8 560.60	2	....
7 689.13	2	....	8 261.03	2	....	8 612.62	2	....
7 797.73	2	....	8 300.58	2	....	8 647.59	2	....
7 835.81	2	....	8 310.22	2	....	8 772.08	3	....
7 859.05	2	....						

CHLORINE

	Wave length.	Spark.	Geissler tube.	Wave length.	Spark.	Geissler tube.	Wave length.	Spark.	Geissler tube.
IV	538.08	....	3	2 532.5	....	7	3 805.2	2	6
	556.4	....	4	2 577.1	....	6	3 820.3	1	5
	561.5	....	4	2 580.7	....	8	3 827.7	2	5
	574.3	....	4	2 601.2	....	5	3 833.4	2	8
	586.9	....	4	2 603.5	....	6	3 843.	2	5
V	629.33	....	6	2 609.50	....	7	3 845.4	....	8
V	633.18	....	6	2 611.4	....	5	3 845.7	2	8
V	635.31	....	6	2 616.99	....	8	3 851.0	....	10
V	639.24	....	5	2 620.07	....	6	3 851.5	3	8
	653.7	....	4	2 624.72	....	6	3 861.	5	10
	663.2	....	4	2 658.7	....	4	3 868.7	1	6
	712.6	....	4	2 661.5	....	4	3 914.	2	5
VI	730.31	....	4	2 665.5	....	6	4 032.2	....	5
	787.8	....	4	2 684.75	....	5	4 104.8	....	4
VII	800 70	....	3	2 685.40	....	5	4 132.5	10	3
VII	813.00	....	2	2 688.03	....	6	4 158.0	2	4
	840.9	....	6	2 691.49	....	6	4 209.7	....	5
	888.0	....	4	2 710.37	....	6	4 226.4	....	7
	960.4	....	6	2 782.4	....	6	4 234.0	....	5
	984.8	....	4	2 996.5	....	5	4 241.3	....	8
	1 008.6	....	4	3 063.0	....	6	4 253.4	2	9
	1 014.9	....	4	3 071.3	1	6	4 291.8	2	5
	1 070.9	....	4	3 076.6	....	7	4 304.1	1	4
	1 145.0	....	2	3 139.2	....	6	4 307.6	3	6
	1 547.2	....	3	3 191.4	3	7	4 323.4	....	6
	1 577.7	....	2	3 259.2	2	4	4 336.3	2	5
	1 821.9	....	2	3 289.7	1	6	4 343.7	5	10
	2 087.1	....	5	3 315.3	1	6	4 363.3	....	8
	2 093.4	....	4	3 320.5	2	8	4 369.5	....	6
	2 251.0	....	5	3 329.0	....	8	4 371.6	....	5
	2 251.5	....	5	3 340.5	3	8	4 373.0	2	6
	2 283.9	....	4	3 353.3	3	7	4 379.9	....	8
	2 359.6	....	4	3 392.8	....	8	4 387.6	....	5
	2 370.4	....	4	3 522.0	....	6	4 389.8	....	8
	2 403.2	....	5	3 602.1	4	2	4 403.4	....	5
	2 434.5	....	5	3 650.1	1	4	4 438.6	....	4
	2 448.6	....	4	3 750.0	....	5	4 469.4	....	5
	2 471.1	....	4	3 781.2	....	5	4 475.3	....	4
	2 519.5	....	6	3 798.8	2	5	4 490.0	1	3

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

Chlorine (Continued)

Wave length.	Spark.	Geissler tube.	Wave length.	Spark.	Geissler tube.	Wave length.	Spark.	Geissler tube.
4 526.3	....	5	4 819.4 p	10	9	5 392.1	2	4
4 572.6	1	5	4 896.7	2	5	5 423.2	2	6
4 601.0	....	4	4 904.7	2	4	5 443.4	1	5
4 768.6	2	4	5 078.2	2	4	5 444.2	....	3
4 781.3	3	5	5 317.8	1	3	5 457.1	....	3
4 794.5 p	10	10	5 321.3	1	4	5 634.9	....	1
4 810.0 p	10	9						

Chromium

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.
202.6	..	1	2 812.01	2	10	3 346.73	4r	1
438.3	..	4	2 822.38	2	10	3 358.50	3	10
456.8	..	4	2 830.48	2	10	3 360.32	3	10
464.0	..	4	II 2 835.64 P	5r	10	3 368.05	4	10
469.8	..	4	II 2 843.25 p	4	10r	3 382.68	2	10
575.3	..	5	II 2 849.83 p	4	10	3 403.32	2	10
619.9	..	6	II 2 855.68 p	4	10	3 408.76	3	10
629.9	..	6	II 2 862.58	3	10	3 421.21	3	9
637.8	..	6	2 879.28	3r	1	3 422.74	3	10
648.7	..	5	2 893.26	3r	1	3 433.60	5r	2
667.1	..	5	2 910.91	4r	1	3 550.64	4	2
681.3	..	5	2 967.64	4r	1	I 3 578.69	10r	10r
840.	..	3	2 971.90	2	10	I 3 593.48	10r	10r
885.2	..	10	2 979.74	2	10	I 3 605.33	10r	10
925.5	..	2	2 985.32	2	10	3 636.59	5r	3
1 004.4	..	3	2 986.47	6r	2	3 639.81	6r	5
1 018.7	..	3	2 989.19	2	10	3 743.56	4r	3
1 816.4	..	10	2 995.11	4r	1	3 743.88	4r	3
2 034.4	2	....	2 996.58	4r	1	3 749.00	4r	3
2 039.3	3	....	2 998.80	4r	1	3 804.80	5	3
2 133.5	3	1	3 005.07	5r	1	I 3 885.22	5r	3
2 150.7	3	1	3 014.77	5r	1	I 3 894.05	4r	3
2 226.5	2	2	3 014.92	6r	1	I 3 908.76	6r	3
2 324.9	..	4	3 017.58	6r	2	I 3 919.17	7r	5
2 408.67	2	1	3 018.50	5r	1	I 3 921.03	5r	3
2 538.3	..	5	3 021.57	6r	2	I 3 928.65	6r	3
2 591.86	4r	1	3 034.20	5r	1	I 3 941.50	5r	3
2 677.17	5r	10	3 037.05	5r	1	3 963.70	7r	8
2 678.79	4	10	3 040.85	5r	10	3 969.75	7r	8
2 691.05	4	10	3 050.14	2	10	3 976.68	7r	8
2 731.90	5r	1	3 053.88	6r	2	3 983.92	7r	5
II 2 743.63	3	8	II 3 118.65	3	10	3 991.13	6r	4
II 2 750.73	3	10	II 3 120.37	4	10	4 001.45	4	2
II 2 751.87	3	10	II 3 124.97	4	10	4 026.17	4	2
2 752.87	3r	1	II 3 132.05	4	10	4 058.79	4	3
2 757.11	4r	2	3 180.73	3	10	4 109.58	4	1
II 2 762.60	3	10	3 197.08	3	10	4 163.63	4	4
II 2 766.54	4r	10	3 209.18	2	10	4 179.26	4	3
2 769.91	6r	1	3 217.40	3	8	I 4 254.34 P	10r	10
2 780.71	7r	....	3 307.05	1	8	I 4 274.80 p	10r	10
2 792.16	1	10	II 3 339.80	3	10	I 4 289.73 p	10r	10
2 800.77	1	10	II 3 342.58	3	10	I 4 337.57	6r	9

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

Chromium (Continued)

	Wave length.	Arc.	Spark.		Wave length.	Arc.	Spark.		Wave length.	Arc.	Spark.
I	4 339.45	6r	5	I	5 345.80	10	6	I	9 009.97	10	....
I	4 339.72	5r	4	I	5 348.31	10	5	I	9 017.08	5	....
I	4 344.51	7r	8	I	5 409.80	10	8	I	9 021.8	4	....
I	4 351.05	5r	4		5 664.03	4	2		9 035.9	3	....
I	4 351.77	7r	9		5 694.73	5	2		9 140.4	1	....
I	4 359.63	6r	8		5 698.33	5	2		9 141.1	1	....
I	4 371.28	6r	9		5 712.77	4	2		9 142.6	1	....
I	4 384.98	6r	7		5 781.81	7	1		9 290.4	10	....
	4 458.53	4	3		5 783.13	8	3		9 294.1	8	....
	4 465.35	4	4		5 783.93	9	3		9 447.0	10	....
I	4 496.86	6r	10		5 785.02	8	3		9 574.2	10	....
	4 511.92	4	6		5 787.98	9	6		9 670.5	5	....
	4 540.71	4	6		5 791.02	10	8		9 734.5	10	....
I	4 545.96	5r	6		5 884.44	3	2		9 948.	2	....
I	4 580.06	7	3		6 102.71	3	1		10 082.	2	....
I	4 591.41	6	2		6 261.27	3	1		10 486.	4	....
I	4 600.75	6r	4	I	6 330.11	6	3		10 673.	3	....
I	4 616.13	6r	6	I	6 362.87	5	3		10 820.	4	....
I	4 626.19	6r	5		6 501.23	3	....		10 906.	6	....
I	4 646.17	7r	10		6 537.95	3	....		11 016.	8	....
I	4 652.17	6r	5		6 661.12	5	2		11 158.	9	....
	4 708.04	7	3		6 669.26	4	....		11 312.	2	....
	4 718.45	7	6		6 715.42	3	....		11 337.	4	....
	4 737.34	5	3	I	6 881.65	9	....		11 392.	5	....
	4 756.13	6	8	I	6 882.41	9	....		11 483.	4	....
	4 789.35	5	3		6 883.04	9	....		11 611.	10	....
	4 801.04	5	2	I	6 924.15	10	....		13 462.	2	....
	4 829.36	5	4	I	6 925.23	9	....		15 680.	3	....
	4 870.80	3	3		6 978.50	10	....		15 861.	3	....
	4 887.01	3	3	I	6 979.81	7	....		18 479.	3	....
	4 922.26	4	3	I	7 355.97	10	....		18 584.	3	....
	4 954.80	4	2	I	7 400.3	10	....		18 654.	3	....
	5 013.31	3	2	I	7 462.4	10	....		18 717.	2	....
	5 166.24	3	4		7 722.9	2	....		25 460.	2	....
I	5 204.54 p	9r	10		7 908.3	2	....		25 490.	1	....
I	5 206.04 p	10r	10		7 942.0	2	....		25 560.	1	....
I	5 208.43	10r	10		8 163 2	3	....		25 584.	2	....
I	5 247.56	5r	3		8 235.9	2	....		25 665.	1	....
I	5 264.15	6r	5		8 348.3	2	....		25 709.	1	....
I	5 265.73	5r	3		8 450.3	2	....		25 785.	1	....
I	5 275.16	4	5		8 455.2	2	....		25 816.	1	....
I	5 296.69	5	6		8 548.8	2	....		25 850.	2	....
I	5 298.28	6	10		8 947.2	2	....		25 902.	1	....
I	5 328.35	10	8		8 976.8	3	....		26 232.	2	....

Cobalt

	342.	..	1	1 882.2	..	4	2 165.6	3	2
	937.	..	5	1 928.	..	6	2 196.6	5	....
	1 128.	..	3	1 940.3	..	6	2 213.9	3	1
	1 502.	..	3	1 950.	..	4	2 276.6	3	1
	1 574.	..	5	1 955.2	..	4	2 286.2 P	2	6r
	1 580.	..	5	1 956.6	..	5	2 307.9 p	2	6r
	1 631.6	..	3	1 969.4	..	5	2 363.8	2	10
	1 772.7	..	5	1 974.1	..	4	2 378.6 p	2	10
	1 790.4	..	4	2 011.5	..	7	2 388.9 p	2	10r
	1 846.	..	4	2 105.	4	1	2 397.4	1	10

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

Cobalt (Continued)

	Wave length.	Arc.	Spark.		Wave length.	Arc.	Spark.		Wave length.	Arc.	Spark.
I	2 407.3	3r	2	I	3 465.79 p	6r	5	I	4 530.97	7	10
I	2 411.6	3r	3	I	3 474.02	9r	8		4 549.66	6	5
I	2 415.3	3r	2		3 485.35	7	3		4 565.61	7	7
	2 424.9	3r	....	I	3 489.40	5r	7	I	4 581.62	8	8
	2 432.3	3r	5	I	3 495.68	6r	5		4 594.62	6	3
	2 447.7	..	10	I	3 502.28	5r	6		4 596.90	6	3
	2 464.2	2	8	I	3 506.32	6r	8	I	4 629.38	8	4
	2 506.4	3	10	I	3 509.85	4r	5	I	4 663.41	8	4
	2 511.1	2r	4	I	3 510.42	4r	4	I	4 682.36	7	3
	2 519.8	1	10	I	3 512.64	4r	6	I	4 749.69	8	3
I	2 528.97	3r	2	I	3 513.48	4r	4	I	4 792.87	7	7
	2 541.95	2	10	I	3 518.35	6r	7	I	4 813.49	8	10
	2 559.40	3	10	I	3 520.09	4r	3	I	4 840.28	8	8
	2 564.04	3	10		3 521.57	5r	5	I	4 867.88	8	8
	2 574.36	3r	....	I	3 523.44	4r	5	I	4 971.95	6	....
	2 632.4	..	10	I	3 526.85	9r	6	I	5 122.76	5	1
	2 648.65	4	10	I	3 529.04	4r	3		5 133.45	5	1
	2 663.53	4	10	I	3 529.81 p	8r	6		5 176.07	6	....
	2 675.99	4	4	I	3 533.36	6r	4	I	5 212.70	5	1
	2 731.11	4	2	I	3 550.60	5r	3	I	5 230.21	5	1
	2 745.10	4	3	I	3 564.95	5r	4		5 266.49	6	1
	2 766.22	4	2	I	3 569.38	7r	10	I	5 280.63	5	1
	2 815.55	4	1	I	3 574.96	5r	4		5 342.68	8	2
	2 886.45	5	2	I	3 575.36	6r	5		5 343.38	7	2
I	2 987.17	5r	3	I	3 587.19	8r	10	I	5 352.05	8	2
I	2 989.59	6r	3	I	3 602.08	5r	4		5 353.48	7	2
I	3 044.00	8r	4	I	3 627.81	8r	4		5 362.76	8	1
I	3 072.34	5r	3		3 639.44	10	2	I	5 369.59	7	1
I	3 082.61	5r	3		3 676.56	8	6		5 444.56	8	1
I	3 086.77	6r	3		3 683.05	8	8		5 454.55	9	1
I	3 137.32	6r	3	I	3 704.06	8	7	I	5 483.35	10	2
I	3 139.94	7r	3		3 732.40	8	7	I	5 530.77	8	1
I	3 147.06	7r	3	I	3 745.50	6r	10	I	5 590.73	8	1
I	3 149.30	6r	2		3 755.45	6r	4		5 647.22	8	1
I	3 158.76	6r	3	I	3 842.06	6r	10		5 830.06	7	....
I	3 159.66	6r	1	I	3 845.48	10r	10		5 890.48	7	2
	3 243.84	8r	2	I	3 861.17	7r	10		5 915.53	8	3
	3 247.17	7r	2	I	3 873.12	9r	10		5 946.51	8	1
	3 254.20	10r	2	I	3 876.84	8r	5	I	5 984.19	10	2
	3 260.81	7r	2	I	3 894.09	9r	10		5 991.88	10	5
	3 265.35	6r	1	I	3 935.97	6r	10		6 000.71	8	1
	3 283.45	10r	3	I	3 941.74	5r	4		6 006.30	8	2
	3 319.48	10	2	I	3 957.94	6r	4		6 007.63	8	2
I	3 334.15	5r	4	I	3 974.73	5r	4		6 049.06	10	2
	3 346.94	10	2	I	4 995.31	8r	10		6 082.46	10	5
I	3 354.38	6r	4	I	3 997.91	7r	10		6 086.66	7	2
	3 377.06	8r	1	I	4 020.90	7r	5	I	6 093.14	6	2
I	3 385.228	9r	4	I	4 045.40	8r	5		6 107.93	7	1
I	3 388.18	9r	5	I	4 066.39	7r	5		6 122.68	10	2
I	3 395.38	10r	5	I	4 086.32	8	9	I	6 188.98	8	3
I	3 405.12	7r	10	I	4 092.40	8r	8		6 211.13	8	1
I	3 409.18	4r	6	I	4 110.54	9	10	I	6 231.02	7	3
I	3 412.34	4r	4	I	4 118.78	8r	10		6 257.61	10	3
I	3 433.04	6r	6	I	4 121.33	10r	10r		6 271.40	10	....
I	3 443.65	3r	6		4 160.7	1	8	I	6 282.65	10	4
I	3 449.17	6r	5	I	4 190.71	7	4		6 320.35	10	2
I	3 449.45	6r	5		4 252.30	5	2		6 347.79	10	1
I	3 453.51 P	6r	10		4 339.64	5	3		6 395.19	7	1
I	3 462.81	6r	5	I	4 469.57	8	5		6 417.80	8	1

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

Cobalt (Continued)

	Wave length.	Arc.	Spark.		Wave length.	Arc.	Spark.		Wave length.	Arc.	Spark.
	6 429.89	7	....		7 840.1	7	....		9 544.5	2	....
I	6 450.23	10	6		7 855.9	7	....		9 597.9	2	....
	6 455.02	10	5		7 869.9	6	....		10 020.7	..	....
	6 477.89	9	....		7 871.4	6	....		10 189.2	..	....
	6 490.32	7	1		7 908.8	10	....		10 206.1	..	....
	6 563.40	9	3		7 926.6	8	....		10 210.8	..	....
	6 595.90	6	3		7 987.4	7	....		10 213.3	..	....
	6 617.30	10(?)	1		8 007.3	10	....		10 236.4	..	....
	6 632.44	6	2		8 022.2	7	....		10 272.9	..	....
I	6 678.81	6	....		8 029.3	7	....		10 284.6	..	....
I	6 771.05	10	2		8 043.3	8	....		10 366.6	..	....
I	6 814.96	10	1		8 056.0	8	....		11 275.5	..	....
	6 872.38	7	2		8 066.5	7	....		11 293.5	..	....
	6 937.8	7	....		8 094.0	10	....		11 340.8	..	....
I	7 016.6	10	....		8 116.4	7	....		11 453.4	..	....
	7 027.82	8	....		8 152.0	6	....		11 634.	2	....
I	7 052.85	10	....		8 193.1	8	....		11 895.	1	....
	7 054.04	8	....		8 208.7	8	....		14 062.	4	....
I	7 084.97	10	....		8 269.4	8	....		14 559.	2	....
	7 134.33	8	....		8 299.0	5	....		14 611.	4	....
I	7 154.7	8	....		8 372.8	10	....		14 681.	2	....
	7 159.16	8	....		8 378.4	7	....		14 958.	3	....
	7 193.60	8	....		8 575.3	4	....		15 210.	2	....
	7 285.3	7	....		8 819.2	10	....		16 133.	5	....
I	7 354.6	6	....		8 835.2	8	....		16 257.	5	....
	7 388.7	7	....		8 850.7	10	....		16 388.	3	....
I	7 417.4	8	....		8 870.8	4	....		16 447.	2	....
	7 457.4	8	....		8 904.7	8	....		16 574.	3	....
	7 554.0	8	....		8 926.2	10	....		17 005.	5	....
	7 590.6	6	....		8 958.5	6	....		17 080.	3	....
	7 610.3	6	....		9 037.9	8	....		18 176.	3	....
	7 712.7	9	....		9 095.4	6	....		18 274.	2	....
	7 734.3	6	....		9 357.0	10	....		19 779	3	....
	7 838.2	8	....								

Columbium

	2 584.03	2	6	I	3 580.27	10	3		4 079.73 p	10	6
H	2 697.07	3	7		3 697.84	10	3		4 100.97	10	6
H	2 927.82	8	10		3 713.05	10	3		4 123.85 p	10	4
I	2 941.57	4	8		3 726.24	10	3		4 129.97	10	3
H	2 950.91	6	10		3 739.82	10	3		4 137.13 p	10	4
H	3 094.19 P	10	10		3 740.80	10	5		4 139.74	10	4
H	3 130.78 p	8	10		3 742.41	10	3		4 152.63	10	5
H	3 163 37 p	5	10		3 759.57	10	3		4 163.64	10	10
H	3 194.95 p	5	10		3 787.08	10	3		4 164.66	10	5
H	3 225.47 p	5	10		3 790.14	10	3		4 168.13	10	5
H	3 236.44	3	10		3 791.24	10	4		5 190.91	10	4
	3 341.95	10	4		3 798.11	10	4		4 192.07	10	3
	3 358.38	10			3 802.98	10	4		4 205.32	10	3
	3 498.62	10	2		3 810.48	10	3		4 214.74	10	3
I	3 510.30	3	8		3 818.92	1	8		4 217.95	10	3
I	3 535.30	10	3		3 914.71	10	3		4 229.15	10	3
I	3 537.50	10	2		3 937.47	10	3		4 262.10	8	3
I	3 554.62	10(?)	2		3 966.23	10	3		4 299.63	8	4
I	3 563.53	10	2		4 032.55	10	3		4 301.10	10	5
I	3 575.85	10	2		4 058.97 P	10	10		4 326.37	10	3

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

Columbium (Continued)

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.
4 331.42	10	3	4 713.48	5	3	5 437.29	7	2
4 351.60	10	3	4 733.88	5	3	5 551.38	6	2
4 377.90	10	4	4 810.57	6	3	5 664.72	6	2
4 410.22	10	3	4 816.33	7	1	5 665.57	6	3
4 437.23	10	8	4 924.84	3	8	5 671.1	7	1
4 447.22	10	3	4 989.0	5	2	5 729.2	6	2
4 523.40	8	3	5 039.04	6	2	5 787.53	6	2
4 546.83	10	4	5 078.95	8	3	5 819.47	6	3
4 573.09	10	5	5 095.29	10	3	5 838.66	8	5
4 581.64	10	5	5 134.73	5	2	5 866.5	6	3
4 606.76	10	10	5 160.33	6	3	5 900.62	10(2)	2
4 630.12	10	10	5 164.36	7	2	5 983.26	7	2
4 648.94	7	3	5 180.30	6	2	6 430.50	8	1
4 663.83	9	4	5 271.53	9	3	6 544.67	6	1
4 672.10	10	9	5 276.20	10	3	6 677.34	8	1
4 675.38	10	8	5 344.15	10	5	6 723.66	6	1
4 708.26	7	4	5 350.72	7	3	6 828.14	4	....

Copper

155.7	..	0	2 400.10	2	5	3 317.20	5	2
324.5	..	6	I 2 441.62	5	2	3 337.85	8	1
329.2	..	5	2 473.46	1	4	3 365.36	6	2
358.0	..	5	I 2 492.15	5r	2	3 381.43	3	1
452.8	..	7	2 506.4	1	6	3 402.23	4	1
777.3	..	5	2 529.43	1	5	3 450.33	7	5
788.3	..	6	I 2 618.39	10r	3	3 454.72	6	3
1 594.	..	5	2 701.1	1	5	I 3 457.85	4	1
1 642.	..	8	2 713.6	1	5	3 483.75	6	3
1 652.	..	6	I 2 766.39	10	4	I 3 512.11	6	3
1 670.	..	6	2 824.38	10	5	3 520.00	4	1
1 672.	..	6	2 882.95	6	3	3 527.49	5	1
1 679.	..	6	2 961.18	9	6	3 530.38	7	2
1 687.	..	6	2 997.37	6	4	3 533.74	7	1
1 702.	..	5	3 010.84	7	1	I 3 599.14	8	2
1 722.	..	6	3 036.10	8	2	3 602.04	8	2
I 1 741.	..	6	I 3 063.42	7	3	3 621.23	6	2
1 750.	..	6	3 073.82	5	2	3 600.54	3	1
1 769.	..	4	3 094.00	6	2	3 741.25	3	1
1 783.	..	3	3 099.92	6	3	3 771.9	3	1
1 840.	..	8	3 108.60	8	5	I 3 861.75	3	1
1 979.2	4	1	3 116.33	7	2	I 4 022.70	10	8
1 999.6	5	2	3 126.10	7	3	I 4 062.7	10	7
2 149.	1	3	3 128.67	6	2	I 4 063.4	6	1
2 199.62	4r(2)	2	3 140.33	6	2	4 177.7	6	2
I 2 214.57	4r	2	3 142.43	7	2	4 248.97	6	4
I 2 227.75	4r	2	3 146.82	6	2	4 275.13	8	8
2 230.08	4r	2	I 3 194.10	8	3	4 378.2	8	8
2 242.60	2	6	3 208.20	6	2	I 4 480.38	7	2
2 246.98	3	6r	3 231.17	4	2	4 509.39	6	3
I 2 263.1	3r	2	3 243.15	6	4	I 4 530.84	8<	2
2 276.24	1	4	I 3 247.55	10r	10r	4 587.00	10	10
2 293.85	6r	3	I 3 273.97 p	10r	10r	4 651.17	8	7
2 294.34	3	5	3 279.80	5	3	4 674.78	5	3
2 356.63	2	4	3 290.55	10	6	4 704.60	4	2
I 2 369.88	5	8	3 293.92	4r	2r	5 016.63	2	2
I 2 392.64	7	1	3 307.95	9	7	I 5 105.55	7	6

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

Copper (Continued)

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.
I 5 153.26	8	8	6 268.3	6	....	I 7 933.23	10	....
I 5 218.20	10	10	6 325.4	4	....	I 8 092.77	10	....
I 5 220.06	6	5	6 474.20	5	....	I 16 008.	5	....
5 292.54	4	4	6 485.16	5	....	I 16 653.	4	....
5 535.8	1	1	6 672.23	5	....	I 18 194.	7	....
5 554.94	2	1	6 741.4	6	....	I 18 229.	5	....
I 5 700.24	5	4	6 905.9	6	....			
I 5 782.15	6	6	7 570.1	5	....			

Dysprosium

2 422.75	3	....	3 724.42	5	5	4 832.43	5	1
2 560.19	3	....	3 757.37	4	3	4 890.12	5	1
2 600.17	3	....	3 786.20	6	5	4 923.14	6	1
2 634.80	3	1	3 806.25	6	10	4 957.41	10	2
2 772.59	3	....	3 836.49	6	4	5 003.86	5	....
2 816.38	3	2	3 898.54	6	10	5 032.98	6	....
2 877.90	3	1	3 944.69	10	10	5 120.01	5	....
2 906.39	3	1	3 968.42	10	10	5 139.58	8	1
2 948.30	3	1	3 978.57	6	10	5 169.64	6	....
2 985.92	3	1	3 996.72	5	4	5 197.66	8	....
3 016.98	3	1	4 000.50 p	8	10	5 260.58	5	....
3 043.46	4	1	4 046.00 p	10	4	5 301.59	5	....
3 141.09	4	2	4 077.98 p	10	10	5 380.68	6	....
3 162.79	4	3	4 103.34	8	8	5 389.58	6	....
3 216.60	5	3	4 111.35	8	4	5 423.30	5	....
3 235.87	5	3	4 146.06	6	2	5 515.40	5	1
3 269.12	5	1	4 167.99 p	10	4	5 547.27	5	....
3 282.78	5	3	4 183.68	6	3	5 600.68	5	....
3 308.87	6	3	4 186.80	8	4	5 651.99	6	....
3 319.87	6	3	4 194.85	8	4	5 685.57	4	....
3 353.57	5	2	4 211.74 p	10	5	5 702.91	4	....
3 385.03	6	3	4 215.13	6	3	5 740.23	3	....
3 393.58	6	3	4 221.12	8	3	5 805.55	3	....
3 407.77	8	3	4 225.14	6	3	5 868.18	3	....
3 413.77	6	3	4 256.33	8	3	5 915.18	3	....
3 454.36	6	10	4 295.02	6	5	5 974.52	5	....
3 484.66	6	3	4 308.66	5	4	6 010.85	5	....
3 494.47	8	5	4 358.50	5	2	6 088.27	6	....
3 524.03	5	10	4 375.33	5	2	6 168.47	6	....
3 531.70	10	10	4 409.40	8	3	6 259.12	10	....
3 536.04	5	5	4 449.72	8	4	6 343.32	5	....
3 546.83	6	4	4 503.25	5	2	6 386.89	5	....
3 550.21	8	10	4 577.81	6	3	6 421.95	6	....
3 563.12	6	4	4 589.35	10	5	6 486.62	5	....
3 576.89	6	3	4 612.27	8	4	6 579.42	6	....
3 600.34	6	10	4 698.72	4	2	6 667.93	6	....
3 645.40	8	10	4 731.84	10	3	6 747.96	3	....
3 676.56	3	10	4 745.79	6	2	6 835.51	6	....
3 694.75	6	10	4 775.81	6	1	6 899.40	4	....
3 698.17	4	10	4 825.00	5	1			

Erbium

2 910.36	5	4	3 025.91	4	2	3 154.28	4	3
2 964.52	4	3	3 070.77	4	2	3 230.95	5	....

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

Erbium (Continued)

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark
3 267.11	5	4	4 522.67	6	....	5 456.58	5	1
3 312.42	6	5	4 552.12	6	4	5 485.93	5	2
3 368.07	6	4	4 563.28	6	3	5 593.40	4	1
3 372.77	10	10	4 606.62	5	3	5 601.19	4	1
3 401.84	4	4	4 630.91	6	4	5 626.52	4	1
3 464.50	5	2	4 675.61	5	10	5 665.45	4	2
3 499.12 p	10	10	4 679.07	6	5	5 710.88	4	1
3 599.84	5	8	4 724.54	6	2	5 739.17	5	1
3 638.68	6	1	4 731.61	6	3	5 757.62	5	1
3 692.65 p	..	10	4 751.55	6	2	5 762.80	5	1
3 729.56	5	5	4 762.65	6	3	5 826.78	6	1
3 766.26	10	3	4 795.50	8	3	5 902.10	5	....
3 787.88	6	3	4 820.33	6	4	6 006.80	5	....
3 797.08	6	3	4 831.14	8	3	6 076.46	5	....
3 830.54	6	6	4 848.83	6	2	6 221.01	6	1
3 892.72	6	2	4 861.60	5	1	6 299.43	5	....
3 896.26	6	6	4 872.09	5	3	6 308.79	8	....
3 906.34 p	10	10	4 900.09	5	4	6 326.13	5	....
3 938.65	8	4	4 951.73	8	3	6 388.19	6	....
3 969.46	5	2	5 007.24	5	1	6 441.33	5	....
3 987.64	5	1	5 028.90	5	1	6 583.47	5	....
4 007.96	10	4	5 042.06	5	2	6 601.11	6	....
4 048.34	5	3	5 127.41	5	2	6 616.75	4	....
4 087.66	10	1	5 133.83	5	2	6 721.93	4	....
4 123.10	6	....	5 188.91	5	2	6 759.88	4	....
5 151.11	6	4	5 218.22	5	2	6 848.11	4	....
4 194.81	10r	2	5 255.93	6	2	6 897.53	3	....
4 230.19	6	3	5 279.31	5	....	6 951.87	3	....
4 276.50	6	3	5 302.31	5	1	7 001.44	3	....
4 319.95	5	3	5 344.49	5	1	7 135.69	3	....
4 374.95	10	6	5 395.86	6	2	7 316.29	3	....
4 419.62	8	10	5 414.63	6	1	7 469.46	5	....
4 473.51	5	4	5 422.79	5	1	7 680.00	3	....
4 500.75	8	6	5 454.25	5	1			

Europium

2 727.77	4	6	4 594.07	10	10	5 967.09	10	1
2 906.68	5	5	4 627.26	10	10	6 083.89	9	1
3 111.43	5	1	4 661.90	10	10	6 173.03	10	3
3 334.32	5	2	4 911.40	8	2	6 188.10	10	2
3 688.42	10	10	5 022.91	6	1	6 262.26	10	2
3 724.97	10	10	5 133.52	5	1	6 303.42	10	3
3 819.64	10r	10	5 223.48	5	1	6 350.02	10	1
3 907.10	10	10	5 357.61	9	1	6 437.63	10	5
3 930.51	10	10	5 402.77	10	2	6 501.57	7	....
3 971.95	10	10	5 451.52	9	2	6 645.20	10	10
4 129.72 p	10	10	5 452.95	9	2	6 802.78	10	....
4 202.01	10	....	5 547.44	10	1	6 864.57	10	....
4 205.01 p	10	10	5 570.31	10	1	7 077.14	8	....
4 435.54	10	10	5 577.12	9	1	7 194.80	8	....
4 522.56	10	10	5 831.98	10	3	7 217.55	8	....

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

Fluorine

	Wave length.	Geissler tube.	Spark.	Wave length.	Geissler tube.	Spark.	Wave length.	Geissler tube.	Spark
	378.6	1	....	3 164.1	4	....	I 6 239.66	6	....
	420.1	1	....	3 201.1	3	....	I 6 348.50	6	....
II	430.15	4	....	3 240.8	3	....	I 6 413.65	5	....
II	467.70	7	....	3 262.7	3	....	6 569.72	2	....
II	546.84	4	....	3 416.4	4	....	6 762.9	2	....
V	572.65	4	....	3 473.5	5	....	I 6 774.00	6	....
II	605.67	8	....	3 475.2	5	....	I 6 834.29	8	....
II	606.27	7	....	3 501.9	8	....	I 6 856.05 p	10	....
II	606.81	9	....	3 503.3	9	....	I 6 870.25	7	....
II	606.95	4	....	3 505.8	10	....	I 6 902.49 p	9	....
II	607.48	7	....	3 598.9	5	....	I 6 909.88	7	....
II	608.06	8	....	3 601.	5	....	I 7 037.56	9	....
II	656.10	7	....	3 602.7	5	....	7 202.4	3	....
II	656.86	6	....	3 847.1	5	....	7 311.2	4	7
II	658.34	8	....	3 850.0	5	....	7 332.1	5	10
V	676.06	4	....	3 851.7	5	....	I 7 398.8	6	10
V	677.17	5	....	3 898.8	5	....	7 426.	3	6
V	679.19	5	....	4 025.1	10	....	7 482.95	1	2
I	951.81	5	....	4 103.4	10	....	7 552.2	2	2
I	954.78	7	....	4 246.3	10	....	7 573.5	2	2
I	955.53	6	....	4 299.1	8	....	7 754.9	5	2
I	958.49	5	....	4 446.8	10	....	7 800.6	4	1
	3 151.7	3	....						

Gadolinium

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.
2 564.51	..	6	3 494.41	5	5	3 894.72	6	4
2 628.12	..	10	3 545.78	9	10	3 916.57	9	8
2 655.59	..	6	3 549.37	7	10	3 934.81	6	3
2 679.41	..	8	3 584.96	8	10	3 957.69	5	5
2 717.30	..	8	3 592.69	5	8	3 959.51	7	6
2 904.73	..	10	3 613.42	5	4	3 994.20	5	3
2 955.50	..	10	3 646.19 p	10	10	4 037.34	9	6
2 999.06	5	4	3 654.64	7	8	4 037.89	7	5
3 010.15	5	6	3 656.15	7	8	4 049.44	6	4
3 027.60	6	6	3 664.64	7	10	4 049.90	8	6
3 032.85	7	8	3 671.24	10	8	4 063.46	10	5
3 034.06	7	6	3 687.76	5	5	4 070.36	9	5
3 082.00	10	6	3 697.74	5	5	4 073.80	8	8
3 100.51	8	8	3 712.71	6	10	4 078.46	5	4
3 145.00	5	4	3 716.38	5	4	4 078.73	5	3
3 350.48	7	10	3 719.48	9	10	4 085.59	8	8
3 358.60	7	8	3 730.87	5	5	4 098.64	8	6
3 362.25	6	10	3 743.41	7	10	4 098.91	5	4
3 416.93	5	4	3 758.29	5	4	4 130.39	10	10
3 418.72	7	4	3 768.40 p	10	10	4 132.29	5	5
3 422.46	8	10	3 770.70	4	5	4 137.10	6	8
3 439.21	6	5	3 796.43	9	10	4 184.28	9	10
3 440.06	7	6	3 813.99	9	6	4 197.68	5	5
3 450.38	5	6	3 850.69	7	4	4 212.00	7	5
3 481.33	6	8	3 851.00	7	5	4 214.97	6	5
3 481.83	5	5	3 852.50	10	8	4 217.15	5	5

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

Gadolinium (Continued)

Wave length.	Arc.	Spark.	Wave length	Arc.	Spark.	Wave length.	Arc.	Spark
4 225.10	5	3	4 732.58	5	4	6 857.14	5	....
4 225.87	7	3	4 743.64	6	3	6 887.65	5	....
4 238.77	5	4	4 758.67	6	2	6 916.58	7	....
4 251.75	8	10	4 767.23	6	2	6 957.71	4	....
4 262.09	9	10	4 786.80	5	1	6 985.86	7	....
4 280.54	7	5	4 801.03	5	3	6 991.89	6	....
4 316.05	5	3	4 821.69	6	2	6 996.77	10	....
4 325.66	9	5	5 015.03	6	2	7 006.13	5	....
4 327.11	8	4	5 092.24	5	2	7 037.24	5	....
4 341.25	7	5	5 103.46	5	1	7 050.97	4	....
4 342.18	10	10	5 155.84	6	1	7 054.61	4	....
4 346.45	8	2	5 342.98	5	1	7 068.07	4	....
4 347.25	5	3	5 350.36	5	1	7 118.90	4	....
4 387.63	5	3	5 353.21	5	1	7 122.58	5	....
4 401.86	5	3	5 370.69	5	....	7 147.37	5	....
4 406.67	4	10	5 393.64	8	....	7 168.3	10	....
4 419.04	5	8	5 535.16	7	....	7 172.30	6	....
4 421.27	3	8	5 617.91	5	....	7 189.64	5	....
4 422.44	6	3	5 643.24	5	....	7 201.43	4	....
4 436.18	6	10	5 696.20	8	....	7 252.72	5	....
4 438.23	5	8	5 701.35	5	....	7 262.7	5	....
4 476.13	5	3	5 733.86	6	1	7 301.24	4	....
4 506.24	6	2	5 751.85	5	....	7 313.28	4	....
4 519.62	5	3	5 754.20	5	....	7 324.91	5	....
4 540.01	4	10	5 913.56	4	1	7 394.91	4	....
4 582.50	5	3	6 114.07	6	1	7 464.37	4	....
4 596.97	4	4	6 305.16	5	1	7 563.02	6	....
4 597.90	4	5	6 634.4	5	....	7 733.50	4	....
4 601.03	5	5	6 752.67	5	....	7 846.36	3	....
4 683.34	5	2	6 828.30	6	....			
4 728.46	6	4	6 846.61	8	....			

Gallium

124.	..	0	1 192.9	..	6	1 845.0	..	8
425.	..	4	1 195.0	..	6	2 294.	1r	2
509.	..	3	1 228.0	..	7	2 338.	1r	....
511.	..	3	1 258.8	..	9	2 371.30	1	3
645.	..	2	1 264.6	..	6	2 418.70	1	4
800.4	..	5	1 267.1	..	7	I 2 450.07	1	4
828.8	..	5	1 279.2	..	7	I 2 500.18	2	7
839.9	..	5	1 285.3	..	7	I 2 659.87	2	7
860.4	..	5	1 293.5	..	6	I 2 719.66	3	8
874.4	..	6	1 295.9	..	10	2 780.2	..	9
909.3	..	5	1 299.5	..	9	I 2 874.24	10r	2
938.5	..	6	1 303.5	..	10	I 2 943.65	10r	2
989.5	..	6	1 338.1	..	7	I 2 944.20	5r	1
1 050.2	..	6	1 414.4	..	10	3 004.1	..	6
1 102.7	..	7	1 483.9	..	6	3 575.3	..	7
1 120.6	..	5	1 495.4	..	10	3 806.8	..	5
1 133.6	..	6	1 534.5	..	10	4 033.01 p	10r	10
1 135.9	..	5	1 586.3	..	8	4 172.05 P	10r	10
1 136.9	..	5	1 625.3	..	7	4 864.9	..	5
1 158.1	..	7	1 799.2	..	7	I 6 396.8	10	5
1 163.5	..	6	1 802.3	..	7	I 6 413.74	8r	....
1 170.4	..	9	1 813.9	..	9			

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

Germanium

Wave length.	Arc.	Spark.	Geissler tube.	Wave length.	Arc.	Spark.	Geissler tube.
547.0	..	1	.....	I 2 533.24	3	6	.....
760.3	..	3	.....	2 556.29	1	....	.....
847.9	..	5	.....	I 2 589.20	3	5	.....
868.3	..	6	.....	I 2 592.55	10	10r	.....
892.6	..	5	.....	2 644.18	2	2	.....
915.0	..	8	.....	I 2 651.18 p	10	10r	.....
936.7	..	9	.....	I 2 651.58 p	10	10r	.....
938.9	..	6	.....	I 2 691.35	10	10	.....
989.0	..	6	.....	2 709.68	10	10r	.....
995.7	..	8	.....	2 740.44	8	7	.....
996.5	..	8	.....	I 2 754.59	10	10r	.....
1 004.2	..	6	.....	2 793.94	3	2	.....
1 011.2	..	9	.....	2 829.01	3	2	.....
1 016.5	..	8	.....	2 845.4	..	4	.....
1 045.5	..	7	.....	I 3 039.09 p	10r	10r	.....
1 058.8	..	6	.....	3 067.04	7	1	.....
1 072.4	..	6	.....	I 3 124.83	10	5	.....
1 088.3	..	8	.....	I 3 269.50 p	10	10	.....
1 098.6	..	5	.....	4 179.0	..	10	.....
1 105.0	..	6	.....	I 4 226.73 p	7	10	.....
1 116.8	..	6	.....	4 260.81	..	10	.....
1 138.0	..	8	.....	4 291.56	..	3n	.....
1 159.5	..	8	.....	I 4 685.84	5	10	.....
1 160.8	..	8	.....	4 743.8	..	2	.....
1 173.7	..	6	.....	4 814.70	..	9	8
1 183.4	..	8	.....	4 854.74	6	....	.....
1 189.0	..	10	.....	5 131.69	..	7	.....
1 229.8	..	10	.....	5 134.71	..	....	10
1 237.0	..	6	.....	5 178.57	..	....	7
1 393.8	..	8	.....	5 229.37	..	6	.....
1 402.8	..	6	.....	5 564.72	..	....	5
1 500.6	..	6	.....	5 606.98	..	....	1
1 733.	..	6	.....	5 621.41	..	....	0
2 198.71	..	2r	.....	5 691.94	..	....	0
2 314.22	1	3	.....	5 701.88	..	....	4
2 327.93	1	3	.....	5 803.42	..	....	10
2 379.15	1	3	.....	6 021.04	..	....	10
2 417.28	3	10	.....	6 484.2	..	....	5
I 2 497.97	3	7	.....				

Gold

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.
458.	..	1	1 590.	..	3	1 727.	..	3
832.	..	5	1 600.	..	3	1 740.	..	4
854.	..	4	1 622.	..	4	1 767.	..	3
864.	..	5	1 629.	..	3	1 784.	..	5
975.	..	20	1 639.	..	3	1 795.	..	5
1 402.	..	2	1 659.	..	3	1 802.	..	5
1 435.	..	4	1 673.	..	6	1 822.4	..	4
1 488.	..	4(2)	1 694.	..	6	1 845.7	..	3
1 500.	..	4(2)	1 699.	..	3	1 850.1	..	2
1 534.	..	3	1 720.	..	3	1 861.1	..	3
1 562.	..	3	1 726.	..	4	1 871.1	..	3

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

Gold (Continued)

Wave length.	Arc.	Spark.	Wave length	Arc.	Spark.	Wave length.	Arc.	Spark.
I 1 879.1	..	3	I 2 688.7	4	3	3 586.7	..	5
1 886.3	..	4	I 2 700.88	4	3	3 614.0	..	2
1 889.8	..	2	I 2 748.26	6r	4	3 633.25	..	3
1 903.9	..	2	2 780.83	..	3	3 649.1	..	3
I 1 918.9	..	4	2 802.21	..	10	3 706.8	..	4
1 921.0	..	4	2 819.98	..	8	3 804.0	..	5
I 1 951.2	..	3	2 822.7	..	3	3 825.7	..	3
1 977.3	..	3	2 825.4	..	4	3 853.6	1	2
2 000.6	..	3	2 838.0	..	3	3 874.7	..	2
2 082.0	..	3	I 2 883.45	4	3	I 3 897.89	4	8
2 110.7	..	2	I 2 891.95	4	2	I 3 909.39	2	2
2 201.3	..	3	2 905.90	6	3	4 016.1	..	4
2 229.0	..	3	2 907.1	..	4	I 4 040.95	2	2
2 242.7	..	3	2 913.5	4	10	4 052.8	..	5
2 283.3	..	3	2 932.19	5	4	I 4 065.08	6	8
2 291.51	..	3	2 954.4	..	4	I 4 084.14	1	2
2 304.80	..	4	2 963.77	2	1	I 4 241.82	1	3
2 314.67	..	3	2 970.41	2	....	I 4 315.1	1	3
2 340.22	..	3	2 973.25	2N	....	I 4 437.29	4	3
I 2 352.67	4	3	2 990.3	..	5	I 4 488.25	4	4
I 2 364.58	4	2	2 995.0	..	5	I 4 607.4	4	2
I 2 376.25	3	2	I 3 029.21	6>	5	I 4 792.62	8	6
I 2 387.77	4	3	3 033.4	2N	2N	I 4 811.61	3	2
I 2 427.98 P	10r	10r	3 117.0	4	1	I 5 064.61	2	2
2 503.3	..	5	3 122.5	..	5	5 230.30	2	3
I 2 510.51	4	2	I 3 122.79	6r	8	I 5 655.8	2	2
I 2 544.2	4	2	I 3 194.71	4	2	5 759.9	..	3
I 2 590.07	4	2	I 3 204.74	4	3	I 5 837.41	4	6
I 2 641.50	4	4	3 230.61	3	3	I 5 863.0	2	3
I 2 675.95 p	10r	10	I 3 208.31	2	2	I 5 957.0	2	3
2 687.6	..	3	I 3 320.16	3	2	I 6 278.2	4	3
2 688.2	..	3	3 553.55	2	4	I 7 510.7	5	....

Hafnium

2 351.2	5	6	2 861.0	5	6	3 194.2	6	6
2 410.1	5	6	2 861.7	6	6	3 253.7	6	6
2 417.7	5	6	2 866.4	6	6	3 255.3	5	6
2 447.2	5	6	2 898.3 p	6	5	3 312.9	6	6
2 460.5	6	6	2 916.5 p	6	5	3 318.0	5	6
2 469.2	4	6	2 919.6	6	6	3 332.7	6	6
2 512.7	6	5	2 929.6	6	5	3 352.0	6	6
2 513.0 p	6	5	2 968.9	6	5	3 399.8	6	6
2 516.9 p	6	6	2 975.9	5	6	3 410.2	5	6
2 551.4	5	6	3 012.9	6	6	3 479.2	6	6
2 571.7	5	6	3 016.8	6	5	3 505.2	6	6
2 622.8	6	6	3 031.2	5	6	3 552.7	5	6
2 638.7	6	6	3 067.4	6	5	3 561.6	6	6
2 641.4 p	6	6	3 072.9 p	6	5	3 569.0	5	6
2 647.3	6	6	3 080.8	6	6	3 616.9	5	6
2 683.4	5	6	3 101.4	6	6	3 644.3	6	6
2 705.6	6	6	3 109.1	6	6	3 682.2	6	6
2 706.7	6	5	3 134.8 p	6	6	3 701.1	5	6
2 738.7	5	6	3 145.3	5	6	3 719.3	6	6
2 773.4 p	6	6	3 162.6	5	6	3 918.1	6	6
2 820.2 p	6	6	3 172.9	5	6	4 044.4	8	3
2 822.7	6	6	3 176.9	6	6	4 093.2 p	6	6

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

HAFNIUM (Continued)

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.
4 232.4	4	6	5 018.1	6	4	5 550.6	6	4
4 336.7	5	6	5 037.3	6	1	5 552.1	6	4
4 350.5	4	6	5 040.8	6	6	5 719.2	6	4
4 356.3	5	6	5 181.9	6	3	5 902.9	6	3
4 417.9	4	6	5 298.0	6	3	6 644.7	6	....
4 598.9	6	6	5 311.5	6	4	6 789.4	6	....
4 620.8	6	5	5 354.7	6	2	6 819.0	6	....
4 800.5	6	6	5 373.9	6	3	7 131.8	6	....
4 975.2	6	5	5 463.3	6	3			

HELIUM

Wave length.	Geissler tube.	Wave length.	Geissler tube.	Wave length.	Geissler tube.
I 585.? p	10	I 3 187.74	8	I 4 471.48	6
II 1 215.?	.....	I 3 203.17	8	I 4 713.14	3
II 1 640.? p	5	I 3 447.59	2	I 4 921.93	4
I 2 252.81	2	I 3 613.64	3	I 5 875.62 p	10
I 2 306.12	2	I 3 819.60	4	I 6 678.15	6
I 2 385.39	5	I 3 888.65 P	10	I 7 065.19	5
I 2 511.22	5	I 3 964.73	4	I 7 281.35	3
I 2 733.24	7	I 4 026.19	5	I 10 829.	1
I 2 763.80	2	I 4 120.81	3	I 10 830.	5
I 2 829.06	4	I 4 143.76	2	I 20 581.	20
I 2 945.10	6	I 4 387.93	3	I 40 540.	.....

HOLMIUM

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.
2 433.0	..	10	3 574.80	5	10	4 356.72	8	8
2 774.70	..	10	3 598.77	10	10	4 629.1	8	5
2 936.77 p	..	10r	3 626.68	10	8	4 649.8	8	1
3 166.61	5	8	3 627.18	8	8	4 742.0	10	3
3 171.71	5	8	3 662.28 p	10	5	5 566.5	8	....
3 181.50	4	10	3 685.16	3	8	5 674.7	10	....
3 289.37	5	10	3 748.19 p	10	10	5 691.5	10	....
3 343.56	10	10	3 757.26	10	10	5 860.3	10	....
3 398.97	10	10	3 796.73	10	10	5 883.0	10	....
3 410.25	10	8	3 810.73	10	10	5 921.8	10	....
3 414.90	10	10	3 854.07	4	10	5 933.7	10	....
3 416.46	10	10	3 861.68	..	10	5 948.0	10	....
3 421.62	10	10	3 888.96	10	10	5 982.9	10	....
3 425.35	10	10	3 891.01 p	10	10	6 081.8	8	....
3 428.10	10	10	4 040.81	8	3	6 133.6	10	....
3 453.13	10	10	4 045.44	10	10	6 234.2	10	....
3 456.00	10	10	4 053.92	10	8	6 255.7	10	....
3 461.96	10	10	4 065.08	10	5	6 305.4	10	....
3 474.26	10	10	4 103.84	10	10	6 372.6	10	....
3 484.8	10	10	4 108.5	10	5	6 550.9	10	....
3 494.8	10	10	4 127.15	10	5	6 604.9	10	....
3 515.58	10	10	4 173.22	10	....	6 629.0	10	....
3 546.00	10	10	4 254.42	10	8	6 694.3	7	....
3 556.77	8	10	4 350.73	10	5			

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

Hydrogen, First Spectrum

Wave length.	Geissler tube.	Wave length.	Geissler tube.	Wave length.	Geissler tube.
972.54	.....	3 671.34	.....	3 835.40	.....
992.	.....	3 673.7	.....	3 889.06	.....
1 025.73	.....	3 676.34	.....	3 970.07	.....
1 086.	.....	3 679.35	.....	4 101.74	.....
1 215.68 p	.....	3 682.82	.....	4 340.47	.....
3 656.6	.....	3 686.83	.....	4 861.33 p	.....
3 657.6	.....	3 691.55	.....	6 562.73	.....
3 658.0	.....	3 697.15	.....	6 562.85 p	.....
3 660.3	.....	3 703.86	.....	9 500.	.....
3 661.2	.....	3 711.98	.....	10 900.	.....
3 662.2	.....	3 721.95	.....	12 817.	.....
3 663.4	.....	3 734.37	.....	18 751.	.....
3 664.6	.....	3 750.15	.....	26 300.	.....
3 666.1	.....	3 770.06	.....	40 500.	.....
3 667.7	.....	3 797.91	.....	74 000.	.....
3 669.42	.....				

Hydrogen, Second Spectrum

3 990.03	4	4 849.32	5	5 888.16	6
3 991.9	4	4 873.03	5	5 931.4	7
4 062.49	6	4 928.7	9	5 938.62	7
4 069.65	6	4 934.27	6	5 949.91	7
4 087.75	4	4 973.26	6	5 975.44	9
4 171.29	5	5 013.05	6	5 982.55	7
4 177.07	6	5 055.07	6	6 018.30	9
4 205.10	7	5 084.84	5	6 027.98	6
4 212.51	6	5 113.18	5	6 031.9	10
4 412.25	5	5 196.38	5	6 070.00	7
4 447.56	5	5 266.04	5	6 079.80	9
4 460.96	6	5 303.16	7	6 090.93	6
4 490.45	6	5 336.51	5	6 095.98	6
4 498.10	6	5 366.0	5	6 121.78	10
4 568.11	7	5 388.2	7	6 127.3	6
4 572.72	6	5 419.90	6	6 135.35	8
4 580.03	7	5 434.84	5	6 182.98	6
4 582.60	6	5 481.09	5	6 199.38	6
4 625.3	5	5 505.5	5	6 224.81	9
4 627.96	6	5 537.45	6	6 238.37	7
4 631.88	9	5 688.20	6	6 299.40	6
4 634.0	9	5 731.90	6	6 327.04	8
4 662.77	5	5 736.86	7	6 935.8	10
4 683.78	6	5 775.0	6	6 940.4	10
4 719.01	6	5 812.58	9	6 962.6	10
4 723.00	6	5 836.0	7	7 072.	10
4 797.74	5				

Indium

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.
161.8	..	0	684.	..	2	882.	..	4
583.	..	1	752.	..	1	954.7	..	4

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

Indium (Continued)

	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.
	973.	..	3	I 2 306.1	5	7	3 008.2	..	10
	1 031.5	..	5	I 2 340.2	6r	....	I 3 039 36	10r	4r
	1 054.	..	6	I 2 389.6	8r	....	I 3 256 06	10r	8r
	1 082.	..	6	I 2 399.2	4r	....	I 3 258.54	6r	3
	1 222.5	..	6	I 2 460.1	6r	....	I 4 101.8 p	8r	10
	1 233.	..	6	I 2 468.0	4r	....	I 4 511.31 P	10r	10
	1 320.	..	7	I 2 521.4	8r	1	4 638.9	..	10
	1 381.	..	9	I 2 523.9	4r	....	4 656.6	..	10
	1 406.	..	8	I 2 560.2	8r	3	4 681.9	..	10
	1 435.	..	5	I 2 601.8	4r	1	5 248.6	..	10
III	1 488.	..	8	I 2 710.25	10r	3	5 644.87	..	10
	1 521.6	..	9	I 2 713.94	6r	1	I 5 709.7	5	....
	1 533.5	..	9	I 2 753.89	6r	3	5 819.9	4	10
II	1 625.6	..	10	2 836.9	8	....	6 097.0	..	7
III	1 749.2	1	12	2 890.23	..	5	6 197.8	..	6
	1 966.7	2	9	I 2 932.66	6r	4	I 6 847.8	8	....
	1 977.3	2	8	2 941.24	..	8	6 891.3	..	10
	2 062.7	..	8	2 983.0	..	6	6 900.37	6	....
	2 079.2	4	10						

Iodine

Wave length.	Spark.	Geissler tube.	Wave length.	Spark.	Geissler tube.	Wave length.	Spark.	Geissler tube.
1 234.2	....	3	3 686.6	3	8	5 065.5	....	6
1 336.7	....	6	3 688.3	3	8	5 119.3	....	10
1 355.5	....	6	3 724.9	3	8	5 161.2 p	10	10
1 390.9	....	5	3 741.9	3	8	5 204.1	....	10
1 425.7	....	8	3 808.2	5	10	5 216.2	1	10
1 458.2	....	6	3 897.4	5	10	5 234.6	....	10
1 459.2	....	6	3 931.1	....	10	5 245.6	4	10
1 514.8	....	9	3 940.1	....	10	5 265.2	1	10(2)
1 518.3	....	7	4 128.7	2	10	5 269.4	1	10
1 641 1	....	7	4 221.1	3	10	5 309.0	....	8
1 642.5	....	7	4 342.1	1	8	5 338.2	3	10
1 782.9 p	....	9	4 399.0	1	8	5 345.1	3	10
1 830.4	....	10	4 410.1	1	10	5 369.7	1	10
1 844.5	....	9	4 434.3	1	10	5 405.3	1	10(4)
1 876.4	....	7	4 453.0	2	10	5 407.3	1	10
2 062.1 p	....	10	4 512.6	1	8	5 435.7	1	10
3 038 4	4	5	4 528.1	1	8	5 437.9	....	8
3 055.2	10	3	4 574.3	1	10	5 464.7 p	5	10
3 077.9	....	6	4 632.4	2	10	5 491.5	....	8(2)
3 081.7	8	5	4 640.8	....	10	5 493.3	....	8(2)
3 194.0	10	8	4 666.5	....	10	5 496.9	2	10(5)
3 275.0	5	10	4 675.6	....	10	5 598.7	....	6(2)
3 288.3	10	10	4 708.0	....	8	5 612.9	....	6
3 303.0	3	10	4 730.5	1	8	5 625.7	1	10
3 342.5	3	8	4 763.4	1	10	5 678.1	1	10(2)
3 350.1	2	8	4 806.5	....	8	5 690.8	1	10(7)
3 461.0	3	8	4 850.4	....	10	5 710.4	1	10
3 481.8	1	8	4 862.3	....	10	5 738.5	....	10
3 498.0	4	8	4 896.7	....	10	5 739.5	....	10
3 561.2	3	8	4 916.9	....	10	5 774.8	1	10
3 583.3	3	8	4 987.0	....	10	5 787.1	....	6

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

Iodine (Continued)

Wave length.	Spark.	Geissler tube.	Wave length.	Spark.	Geissler tube.	Wave length.	Spark.	Geissler tube.
5 830.0	....	6	6 127.4	....	8	6 339.5	....	6
5 893.8	....	8	6 204.7	....	6	6 359.1	....	4
5 950.1	1	10	6 257.4	....	4	6 488.1	....	4
6 023.9	....	6	6 293.9	....	6	6 560.3	....	4
6 074.9	....	6	6 337.9	....	4	6 585.0	....	4
6 082.3	....	10						

Iridium

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.
2 024.4	..	4	3 448.99	7	4	5 123.66	8	....
2 051.1	..	5	3 513.67 p	9	8	5 177.93	8	....
2 092.7	..	3	3 515.96	6	3	5 238.92	10	....
2 221.1	..	5	3 522.05	6	4	5 273.77	6	....
2 372.78	4	2	3 573.74	6	6	5 340.74	8	....
2 475.11	4	2	3 605.83	2	10	5 364.32	10	....
2 512.57	2	5	3 609.78	6	3	5 385.62	7	....
2 543.98	5	4	3 617.23	6	4	5 390.98	7	....
2 661.99	6	3	3 628.69	7	5	5 449.50	10	1
2 664.77	5	3	3 636.22	6	3	5 454.50	10	....
2 694.22	6	3	3 653.20	1	6	5 620.05	6	....
2 712.72	4	2	3 661.72	5	3	5 625.55	10	....
2 774.98	2	5	3 675.00	4	4	5 709.32	6	....
2 823.18	5	2	3 731.35	4	8	5 736.23	5	....
2 824.44	6	4	3 734.75	2	6	5 768.89	4	....
2 833.23	4	10	3 747.21	5	6	5 778.28	4	....
2 839.18	6	2	3 800.10	6	6	5 828.54	7	....
2 849.74 p	7	4	3 895.6	..	8	5 873.49	5	....
2 924.81 p	8	4	3 915.38	4	6	5 882.29	9	....
2 934.63	6	3	3 976.33	5	10	5 887.38	5	....
2 936.71	5	3	3 992.14	6	6	5 894.09	10	....
2 943.17	7	4	4 020.05	5	8	6 026.12	5	....
2 951.23	5	3	4 033.77	4	4	6 067.85	7	....
3 039.25	5	3	4 069.93	4	8	6 110.68	8	....
3 042.63	2	6	4 115.80	4	5	6 211.33	4	....
3 100.42	8	3	4 259.12	4	2	6 288.3	7	....
3 120.77	5	3	4 268.09	4	5	6 334.45	6	....
3 133.31	6	5	4 311.50	5	4	6 496.9	4	....
3 168.88	5	3	4 399.48	6	8	6 624.74	5	....
3 198.93	5	1	4 426.29	6	4	6 686.08	7	....
3 220.79 P	8	5	4 616.37	6	2	6 830.06	4	....
3 229.28	5	3	4 778.15	4	2	6 888.72	4	....
3 241.52	5	3	4 938.07	10	....	6 893.4	4	....
3 266.45	8	3	4 970.46	8	....	6 929.9	5	....
3 277.28	4	2	4 999.72	10	....	7 037.85	4	....
3 334.19	5	3	5 002.70	10	....	7 183.74	5	....
3 368.50	8	3	5 015.00	10	....	7 834.32	5	....
3 437.05 p	8	4	5 046.06	8	....			

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

Iron

Wave length.	Arc.	Spark.		Wave length.	Arc.	Spark.		Wave length.	Arc.	Spark.
294.3	..	2		2 191.8	5	....		2 383.25	4	2
365.8	..	5		2 196.0	5	....		2 388.63	6	3
381.1	..	4		2 199.5	5	....		2 389.98	4	....
392.9	..	7		2 200.7	5	....		2 395.42	4	3
417.5	..	4		2 213.6	4	....	II	2 395.63 p	8	4
552.1	..	7		2 221.3	4	....		2 399.24	6	5
602.4	..	4		2 229.1	6	....		2 404.43	4	2
609.1?	..	9		2 231.2	7	....	II	2 404.89 p	6	6
666.9	..	4		2 240.6	5	....		2 406.66	6	4
669.9	..	4		2 245.6	6	....	II	2 410.53 p	6	5
859.9	..	4		2 248.9	6	....		2 411.07	6	3
863.2	..	3		2 249.2	7	....		2 413.31 p	6	3
929.2	..	3		2 251.9	6	....		2 439.75	4	1
983.8	..	3		2 253.2	6	....		2 442.57	4	1
1 006.0	..	2		2 255.8	7	....		2 443.87	4	1
1 017.6	..	6		2 260.8	6	....		2 444.5	..	4
1 031.8	..	4		2 265.2	5	....	I	2 447.72	4	2
1 062.1	..	2		2 266.9	5	....		2 453.48	4	1
1 143.4	..	2		2 267.1	5	....		2 457.60	6	1
1 186.4	..	2		2 267.6	5	....	I	2 462.19	6	1
1 228.9	..	2		2 272.8	5	....	I	2 462.65	6	1
1 254.1	..	2		2 274.1	5	....		2 465.16	5	....
1 260.8	..	2	I	2 276.0	5	....		2 468.88	5	1
1 272.2	..	2		2 279.9	6	....		2 472.35	5	....
1 373.9	..	2		2 280.2	6	....	I	2 472.87	5	....
1 387.8	..	2		2 287.3	5	....	I	2 472.91	4	1
1 409.4	..	2		2 287.6	5	....		2 473.16	4	....
1 430.6	..	2		2 289.0	6	....		2 474.82	5	2
1 525.5	..	2		2 290.6	5	....	I	2 479.78	4	1
1 532.3	..	2		2 291.1	6	....		2 483.28	5r	1
1 538.3	..	2		2 292.5	5	....		2 483.54	4	....
1 597.7	..	2	I	2 297.8	6	....	I	2 484.19	6	....
1 630.9	..	2	I	2 298.2	7	....		2 486.38	4	3
1 702.0	..	3	I	2 299.2	5	....		2 486.69	4	1
1 718.3	..	2		2 300.1	5	....		2 487.07	4	1
1 724.0	..	2		2 310.01	5	....		2 487 37	4	1
1 787.0	..	5		2 313.1	5	....	I	2 488.15	4	2
1 788.3	..	5		2 327.39	6	....	I	2 489.76	6	....
1 843.9	..	2		2 332.80	6	....	I	2 490.66	4	....
1 869.7	..	4		2 338.01	6	....	I	2 491.16	4	....
1 895.6	..	4		2 343.50	7	....		2 493.3	..	8
1 913.3	..	4		2 344.3	4	....		2 496.54	5	1
1 914.2	..	3		2 348.12	5	....		2 507.90	4	1
1 953.6	..	2		2 348.3	5	....	I	2 510.84	6	1
2 000.3	3	....		2 351.2	4	....		2 511.8	..	5
2 020.6	3	....		2 354.9	6	....		2 512.37	4	....
2 040.6	3	....		2 359.11	6	....		2 517.66	4	1
2 063.7	3	....	II	2 360.3	5	....	I	2 518.11	6	1
2 084.2	4	....		2 362.1	8	....	I	2 522.86	4	3
2 093.7	4	....		2 364.83	8	....		2 523.66	4	1
2 106.4	4	....		2 366.59	5	....	I	2 524.29	6	1
2 139.7	5	....	II	2 368.59	7	....		2 525.4	..	4
2 144.4	5	....		2 370.5	6	....	I	2 527.44	4	2
2 151.7	5	....		2 373.62	4	....	I	2 529.14	6	1
2 159.9	5	....	II	2 373.73	6	4	I	2 529.84	6	....
2 165.8	5	....	II	2 375.19	4	....		2 533.7	..	5
2 166.8	6	....		2 379.28	4	3	I	2 535.61	6	....
2 171.3	5	....		2 380.76	4	3		2 537.18	6	....
2 178.1	5	....	II	2 382.04 P	8	10	I	2 540.98	6	....

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

Iron (Continued)

	Wave length.	Arc.	Spark.		Wave length.	Arc.	Spark.		Wave length.	Arc.	Spark.
	2 542.11	5	1		2 696.29	5	....		2 778.85	4	1
	2 543.93	5	1		2 699.11	4	1		2 779.30	3	4
	2 544.72	4	....		2 704.00	3	4	I	2 781.80	4	1
I	2 549.62	6	....		2 706.59	5	2		2 783.69	3	5
II	2 562.54	5	5		2 708.58	4	1		2 787.94	4	....
	2 563.48	5	4		2 710.55	4	1		2 788.11	6	2
	2 566.92	4	3		2 711.66	5	....		2 789.81	3	1
	2 570.54	3	1	II	2 714.42	6	5		2 791.79	3	1
	2 570.86	3	3		2 714.88	4	....		2 797.78	4	1
	2 574.37	3	4		2 718.45	4	1		2 804.52	7	1
	2 575.76	4	1		2 719.04	7	2		2 806.99	7	2
	2 576.70	4	....		2 719.43	4	2	I	2 813.29	9	2
	2 576.87	4	3	I	2 720.91	7	2		2 823.28	7	2
	2 577.94	4	3	I	2 723.58	6	2		2 825.56	6	1
	2 582.31	4	....		2 724.89	3	3	I	2 825.69	4	1
II	2 582.59	4	4		2 724.96	4	....	I	2 827.89	4	1
	2 584.54	4	1		2 726.06	4	1		2 831.56	3	4
II	2 585.88	7	10		2 726.24	3	1		2 832.44	6	1
	2 587.96	3	....		2 727.39	3	2		2 838.12	6	1
	2 588.01	5	3		2 727.54	5	6		2 843.63	5	1
II	2 591.55	4	4		2 728.03	4	1		2 843.97	7	2
	2 592.80	4	4		2 730.74	4	3		2 845.60	4(2)	2
	2 598.38	7	8	I	2 733.58	9	2		2 848.72	4	1
II	2 599.40	6	10		2 734.01	4	1		2 851.80	8	2
	2 599.57	3	....		2 734.27	4	1	I	2 858.90	4	....
	2 606.83	5	....	I	2 735.48	8	2		2 863.43	4	1
	2 607.10	7	10	II	2 736.97	4	4	I	2 863.87	5	1
II	2 611.88	8	10	I	2 737.31	6	1		2 866.63	4	1
	2 613.84	8	8	II	2 739.55	9	10	I	2 869.31	6	1
	2 617.62	6	6	I	2 742.26	4	1		2 872.34	4	3
	2 618.03	4	1	I	2 742.41	6	1	I	2 874.18	7	1
	2 619.08	3	2	II	2 743.20	6	8		2 877.30	5	1
	2 620.42	3	2	I	2 744.07	8	1		2 887.81	4	1
	2 620.70	3	2		2 744.53	5	1		2 894.51	4	1
	2 621.67	6	4	II	2 746.49	7	10		2 895.04	4	1
	2 623.54	4	1	II	2 746.99	7	8		2 899.42	4	1
	2 625.50	4	3		2 749.18	4	....	I	2 912.16	8	2
II	2 625.68	8	4	II	2 749.32	7	10		2 918.03	5	2
	2 628.30	6	8	I	2 750.15	6	2	II	2 926.58	7	3
I	2 629.60	5	3		2 750.87	4	....	I	2 929.01	7	1
	2 630.08	3	2		2 753.29	4	5	I	2 936.90	7r	2
	2 631.05	6	4		2 753.69	4	1		2 937.81	6	....
	2 631.33	6	3	I	2 754.03	4	1	I	2 941.35	8	3
	2 632.25	4	1	II	2 755.74	8	10		2 944.40	4	4
	2 635.82	4	1	I	2 756.33	5(2)	1		2 947.66	4	4
	2 641.65	3	1		2 757.32	4	1	I	2 947.88	5	3
	2 651.72	3	1		2 759.82	4	1		2 948.44	4	1
	2 656.15	3	1	I	2 761.79	5	2		2 950.25	6	1
	2 664.67	3	4		2 761.81	4	....	I	2 953.94	4	2
	2 666.64	3	4	I	2 762.03	5	1	I	2 957.37	5	2
	2 666.82	4	....		2 763.11	4	1		2 960.00	4	2
	2 679.06	6	2		2 764.33	4	1	I	2 965.26	5	2
	2 681.59	4	....	I	2 766.91	4	1	I	2 966.90	6r	3
	2 684.76	3	4	I	2 767.52	7	5	I	2 969.48	4	2
	2 689.22	5	2		2 772.08	4	....	I	2 970.11	4	2
	2 689.84	4	1	I	2 772.11	6	1	I	2 973.14	4	2
	2 692.61	3	4		2 773.23	4	1	I	2 973.24	4	2
	2 694.54	4	....	I	2 774.73	4	2	I	2 981.45	4	2
	2 696.00	4	....	I	2 778.23	6	1	II	2 984.83	4	6

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

Iron (Continued)

	Wave length.	Arc.	Spark.		Wave length.	Arc.	Spark.		Wave length.	Arc.	Spark.
											I
I	2 987.30	5	1		3 171.35	4	1		3 341.91	4	1
	2 990.40	4	1		3 175.45	6	1		3 347.93	4	1
I	2 994.44	6r	3		3 178.01	6	1		3 355.23	4	
	2 999.52	5	2		3 180.23	8	2		3 370.79	6	2
	3 000.45	4	1	I	3 180.77	4	....		3 378.68	4	1
I	3 000.95	5	2		3 181.53	4	1		3 379.02	4	1
	3 007.15	4	1	I	3 184.90	4	1		3 380.12	5	1
I	3 007.29	4	1		3 188.84	5	1		3 383.70	4	1
	3 008.15	5	2		3 191.66	5	1		3 383.99	5	1
I	3 009.58	5	2		3 192.81	5	2		3 392.31	4	2
	3 011.49	4	1		3 196.94	4	2		3 392.66	5	2
I	3 017.63	5	2	I	3 199.53	6	1		3 394.59	4	1
I	3 018.99	5	2		3 200.48	6	1		3 399.34	6	2
I	3 020.50	5	2		3 205.40	7	1		3 402.26	4	1
I	3 020.65	6r	3		3 210.25	4	1		3 404.35	6(2)	2
I	3 021.08	6r	3		3 210.84	5	1		3 407.46	7(2)	4
I	3 024.04	5	2		3 211.70	4	1		3 413.14	7	3
	3 025.64	4	2		3 212.00	4	2		3 417.85	6	2
I	3 025.85	5	2	II	3 213.32	4	2		3 418.51	5	2
I	3 026.47	6	2		3 214.05	8	2		3 422.66	4	2
	3 030.16	4	2		3 215.94	5	2		3 424.29	6	2
	3 031.22	4	2		3 217.39	4	1	I	3 426.39	4(2)	1
I	3 031.64	5	2		3 219.58	5	....		3 426.64	6	1
I	3 037.39	5	3		3 219.82	4	....		3 427.12	6	4
	3 040.43	4	2		3 222.07	6	3		3 428.20	6	2
I	3 041.75	4	2		3 225.79	8	3	I	3 440.61	7r	4
I	3 042.03	4	1	II	3 227.76	4	5	I	3 440.99	6r	4
I	3 042.67	5	2		3 227.82	4	5		3 442.37	4	1
	3 045.09	4	....		3 228.26	4	1	I	3 443.88	6r	3
I	3 047.61	6	3		3 233.06	5	2		3 445.15	4	2
	3 053.07	4	1		3 233.98	6	....		3 447.28	6	1
	3 055.27	4	....		3 234.62	5	1		3 450.33	6	1
I	3 057.45	5	3	I	3 236.23	5	1		3 451.92	6	1
I	3 059.09	5r	3		3 239.44	8	2	I	3 452.28	4	1
	3 067.12	4	....		3 244.19	8	2		3 459.92	4	1
I	3 067.25	5	3		3 246.97	4	1	I	3 465.87	6r	3
	3 068.18	4	1		3 248.21	6	1		3 468.85	4	1
I	3 075.73	5	3		3 251.24	5	1	I	3 475.46	6r	3
I	3 083.75	4	3		3 254.37	4	2		3 475.65	4	....
I	3 091.58	4	2		3 257.60	4	1	I	3 476.71	5	3
I	3 099.90	4	....		3 264.52	4	1	I	3 483.01	4	1
I	3 099.97	4	4		3 265.05	3	1		3 485.34	6	1
I	3 100.31	4	2		3 265.62	6	2		3 489.67	4	1
I	3 100.67	4	3		3 268.25	4	....	I	3 490.58	6r	4
I	3 116.64	5	1		3 271.01	6	2		3 497.11	4	2
	3 119.50	4	1		3 280.27	5	1	I	3 497.84	5	3
	3 120.44	4	1		3 282.90	4	1		3 506.50	5	1
I	3 125.66	6	2		3 284.59	4	1	I	3 513.82	5	3
	3 129.34	4	....		3 286.76	3	3	I	3 521.27	5	3
I	3 134.11	5	1		3 290.99	4	1		3 524.08	4	1
	3 142.45	4	1		3 292.03	5	1		3 524.24	4	1
	3 142.89	4	1		3 292.60	5	1	I	3 526.02	4	2
	3 143.99	6	1		3 298.14	5	1	I	3 526.17	5	2
	3 151.35	6	1		3 305.98	8	3		3 526.38	3	....
	3 157.04	4	1		3 306.36	8	3		3 526.47	4	1
	3 157.88	4	1		3 314.75	6	1		3 526.67	5	1
	3 160.66	6	1		3 323.74	4	1		3 527.80	4	1
	3 161.95	5	1		3 328.87	4	1		3 530.38	4	1
	3 166.44	4	1		3 337.67	4	1		3 533.01	4	1

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

Iron (Continued)

	Wave length.	Arc.	Spark.		Wave length.	Arc.	Spark.		Wave length.	Arc.	Spark.
	3 533.20	5	2	I	3 687.46	6r	4		3 867.22	3	2
	3 536.56	6	3		3 689.46	6	2	I	3 872.51	6	4
	3 537.73	4	1		3 694.00	6	2		3 873.77	4	2
	3 540.13	4	1		3 701.09	6	2	I	3 878.02	6	4
	3 541.09	6	3		3 704.46	5	2	I	3 878.58	6r	5
	3 542.08	6	3	I	3 705.57	6r	4		3 878.66	4	....
	3 545.64	5	1		3 707.83	3	....	I	3 886.29	7r	5
	3 553.74	5	2		3 707.92	5	4(2)	I	3 887.05	6	3
	3 554.93	8	4	I	3 709.25	6	4	I	3 888.52	7	4
	3 556.88	6	2		3 716.45	6	....		3 891.93	4	1
I	3 558.52	5	4	I	3 719.94 P	8r	10		3 893.40	4	2
I	3 565.38	6r	5	I	3 722.57	6r	4	I	3 895.66	5	3
	3 568.98	4	1		3 724.38	6	2		3 897.90	4	2
I	3 570.10	7r	10	I	3 727.62	6r	5	I	3 898.01	4	2
	3 570.24	7	....		3 732.40	6	1	I	3 899.71	6	4
	3 572.00	7	2	I	3 733.32	6r	3	I	3 902.95	7	5
	3 576.76	4	1	I	3 734.87	9r	10		3 903.90	3	1
	3 581.20	8r	10	I	3 737.14 p	7r	6	I	3 906.48	5	3
	3 582.20	4	2		3 738.31	4	2		3 907.94	3	1
	3 584.66	5	2		3 743.47	4	6	I	3 917.19	5	2
	3 584.96	5	2	I	3 745.56 p	7r	5		3 918.65	4	1
I	3 585.32	6	3	I	3 745.90 P	6	4	I	3 920.26	6	4
I	3 585.71	5	3	I	3 748.27 p	6r	4	I	3 922.92	6r	4
	3 586.12	5	3	I	3 749.49	8r	10	I	3 927.92	6	4
I	3 586.99	6	3	I	3 753.62	5	2	I	3 930.30	7r	4
I	3 589.11	4	1	I	3 758.24	7r	8		3 935.82	4	1
	3 589.45	3	1		3 760.05	5	2	I	3 940.88	4	1
	3 603.21	5	3	I	3 763.79	6r	6		3 942.45	3	1
	3 605.46	5	3		3 765.54	6	3		3 948.78	4	2
	3 606.68	5	4	I	3 767.20	6r	5		3 949.96	4	2
	3 608.86	6r	6		3 785.95	5	2		3 951.17	4	2
	3 612.08	4	1		3 787.88	6r	4		3 952.61	4	1
	3 617.79	6	3		3 790.10	4	2		3 956.46	4	2
I	3 618.77	6r	6	I	3 795.01	6	5		3 956.68	6	3
	3 621.46	6	3		3 797.52	5	3	I	3 966.07	5	2
	3 622.01	6	3	I	3 798.51	6	4		3 967.43	4	2
	3 623.19	5	2	I	3 799.55	6	5	I	3 969.26	7	5
	3 625.15	4	1		3 805.35	6	3		3 971.33	4	1
	3 631.10	5	1		3 806.70	6	3		3 977.75	5	2
I	3 631.47	6r	6	I	3 807.54	4	2		3 983.97	5	2
	3 632.04	6	2	I	3 812.97	6	4		3 997.40	6	3
	3 634.34	5	1	I	3 815.84	7r	10		3 998.06	5	2
	3 637.86	4	1	I	3 820.43	8r	10	I	4 005.25	7	6
	3 638.30	6	2		3 821.18	6	3		4 009.72	5	2
	3 640.39	6	3	I	3 824.45	6r	5		4 014.54	4	2
	3 645.83	4	2	I	3 825.89	8r	8		4 021.87	5	2
I	3 647.85	6r	6	I	3 827.83	6r	8	I	4 045.82	8r	10
	3 649.51	6	3		3 833.31	4	1		4 062.45	4	2
	3 651.74	6	3	I	3 834.23	7r	6	I	4 063.60	8r	10
	3 655.47	4	1		3 839.26	5	2		4 066.98	4	1
	3 659.52	5	1	I	3 840.44	6r	4		4 067.28	3	1
	3 669.52	6	2	I	3 841.05	6r	5		4 067.99	5	1
	3 676.31	4	1		3 843.26	5	2	I	4 071.74	7	8
	3 677.63	6	2	I	3 849.97	6	4		4 074.79	3	1
I	3 679.92	5	3	I	3 850.82	5	2		4 076.64	5	2
	3 682.24	6	3	I	3 856.37	6r	5		4 107.49	5	2
I	3 683.06	4	2		3 859.22	5	2		4 109.81	4	2
	3 684.11	5	2	I	3 859.91	7r	6		4 114.45	4	1
	3 686.00	5	2	I	3 865.53	6	4		4 118.55	6	3

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

Iron (Continued)

	Wave length.	Arc.	Spark.		Wave length.	Arc.	Spark.		Wave length.	Arc.	Spark
	4 127.62	4	1	I	4 531.15	5	2	II	5 169.03	2	5
·I	4 132.06	7	4		4 547.85	3	2	I	5 171.60	7	2
	4 134.68	5	2	I	4 592.66	4	2	I	5 191.46	7	2
	4 143.42	5	3	I	4 602.95	3	2	I	5 192.35	8	2
I	4 143.87	7	5	I	4 607.66	4	1	I	5 194.95	5	1
I	4 147.68	4	1		4 611.29	4	2	I	5 198.72	4	1
	4 154.82	4	2		4 619.30	4	1	I	5 202.34	5	1
	4 156.80	4	2		4 630.13	3	4	I	5 216.28	5	1
	4 175.64	4	2	I	4 632.92	3	1		5 227.19	8	4
	4 181.76	6	4		4 638.02	4	1	I	5 232.95	8	5
	4 184.90	4	2		4 647.44	4	2		5 242.50	3	1
	4 187.05	6	4	I	4 654.50	4	....	I	5 266.57	8	3
	4 187.81	6	4		4 667.46	4	2	I	5 269.54	10	8
	4 191.44	6	3		4 678.86	5	2		5 270.36	8	4
	4 198.31	6	3		4 691.42	4	2	I	5 281.80	5	2
	4 199.10	6	5	I	4 707.28	5	2	I	5 283.63	7	2
I	4 202.03	7	6		4 710.29	3	1	I	5 302.31	5	2
	4 210.36	6	3	I	4 733.60	3	1	I	5 324.19	6	5
	4 216.19	4	1		4 736.78	5	3	I	5 328.04	7	6
	4 219.37	5	3		4 741.53	3	1		5 328.54	4	2
	4 222.22	5	2		4 786.81	3	1		5 341.03	5	2
	4 225.46	4	1		4 789.66	3	2	I	5 371.50	7	6
	4 227.44	7	4	I	4 859.75	2	2		5 383.37	5	6
	4 233.61	6	3	I	4 871.33	8	4	I	5 397.13	6	6
	4 235.95	8	4	I	4 872.15	6	3	I	5 405.78	6	6
	4 238.82	4	2	I	4 878.22	5	2		5 415.19	4	6
	4 247.44	5	2	I	4 890.77	7	4		5 424.06	4	8
	4 250.13	7	4	I	4 891.50	9	5	I	5 429.70	6	6
I	4 250.79	8	6	I	4 903.32	5	2	I	5 434.53	6	5
	4 260.48	10	10	I	4 919.00	8	4	I	5 446.92	6	6
I	4 271.77	8	10	I	4 920.52	10	8	I	5 455.61	6	6
	4 282.41	6	3	I	4 938.83	5	1	I	5 473.91	3	1
I	4 294.13	6	4	I	4 957.31	7	3	I	5 497.52	4	2
	4 299.24	7	4	I	4 957.61	10	8	I	5 501.47	4	2
I	4 307.91	8	10		4 966.10	5	1	I	5 506.78	4	2
I	4 315.09	5	3		4 983.86	4	1		5 563.61	3	1
I	4 325.77	9	10	I	4 994.14	3	1	I	5 569.63	5	2
I	4 337.05	5	2		5 001.87	5	2	I	5 572.85	5	3
	4 352.74	4	2	I	5 006.13	5	2	I	5 576.10	4	1
	4 369.78	3	2	I	5 012.07	4	2	I	5 586.77	6	4
	4 375.93	5	2		5 041.08	3	1		5 598.30	3	1
I	4 383.55	10	10	I	5 041.76	3	1	I	5 615.66	6	4
I	4 404.75	8	10	I	5 049.83	5	2	I	5 624.55	5	1
I	4 408.42	4	1	I	5 051.64	4	1	I	5 658.83	4	1
I	4 415.13	8	10	I	5 079.23	3	1		5 701.55	3	....
	4 422.57	4	2	I	5 079.74	3	1	I	5 709.39	3	1
	4 427.31	5	2	I	5 083.34	4	1		5 717.85	3	....
I	4 430.62	4	1	I	5 098.71	7	1		5 731.77	3	....
I	4 442.35	5	2	I	5 107.65	4	1		5 763.01	4	1
I	4 447.72	5	2		5 110.42	4	1		5 862.35	4	....
I	4 459.13	5	3	I	5 123.73	4	1		5 883.84	4	....
	4 461.66	4	2	I	5 127.36	3	1		5 914.16	6	1
	4 466.56	5	3		5 133.68	5	2		5 930.17	5	....
	4 469.39	4	3	I	5 139.27	6	2		5 934.68	4	1
	4 476.02	7	4	I	5 139.48	8	3		5 952.74	4	1
I	4 482.26	4	4	I	5 150.84	4	1		6 024.06	4	2
	4 489.75	3	1	I	5 151.92	3	1		6 027.06	3	1
I	4 494.57	4	5		5 166.29	3	1		6 065.49	4	2
I	4 528.62	7	6		5 167.49	8	4		6 136.62	4	3

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

Iron (Continued)

	Wave length.	Arc.	Spark.		Wave length.	Arc.	Spark.		Wave length.	Arc.	Spark.
	6 137.70	4	3		7 068.42	5	....		8 999.5	4	....
	6 157.73	2	1	I	7 090.41	6	....		9 079.6	4	....
I	6 173.34	3	1	I	7 130.95	10	....		9 088.2	4	....
	6 191.57	5	3	I	7 164.48	9	....		9 089.4	4	....
I	6 213.44	3	1		7 187.34	10	....		9 100.5	2	....
	6 230.73	5	3	I	7 207.42	10	....		9 118.9	4	....
	6 246.34	4	1	I	7 239.90	4	....		9 210.0	2	....
	6 252.57	4	2	I	7 288.78	4	....		9 258.5	3	....
I	6 265.14	4	1	I	7 293.08	6	....	I	9 350.5	1	....
I	6 297.80	3	....		7 386.40	4	....		9 738.7	2	....
I	6 301.52	5	1	I	7 389.43	7	....		10 063.	2	....
	6 318.03	4	1	I	7 411.19	8	....		10 144.	3	....
I	6 335.34	4	1	I	7 445.78	9	....		11 641.	3	....
	6 336.84	4	1	I	7 495.10	8	....		11 884.	5	....
	6 393.61	5	2		7 511.05	9	....		11 975.	8	....
	6 400.02	5	3		7 531.18	4	....		12 034.	3	....
	6 408.04	4	....	I	7 568.93	4	....		13 564.	5	....
	6 411.67	5	1		7 586.07	7	....		13 899.	5	....
	6 421.36	4	1		7 664.30	4	....		14 237.	4	....
I	6 430.86	5	1		7 748.29	4	....		14 288.	4	....
	6 462.74	4	....		7 780.60	5	....		14 402.	10	....
	6 494.99	5	3		7 832.24	6	....		14 513.	8	....
	6 546.25	5	1	I	7 937.18	9	....		14 558.	4	....
	6 569.23	5	....		7 945.89	7	....		14 711.	2	....
	6 592.92	5	1	I	7 998.98	6	....		14 828.	2	....
	6 609.12	4	....	I	8 046.09	5	....		15 054.	2	....
	6 663.45	4	....		8 085.21	5	....		15 213.	4	....
	6 678.00	5	....		8 220.42	7	....		15 296.	4	....
	6 750.16	4	....	I	8 327.06	8	....		15 396.	3	....
	6 828.61	4	....	I	8 331.95	6	....		15 625.	3	....
	6 841.36	5	....	I	8 387.79	8	....		15 771.	4	....
	6 843.68	4	....	I	8 468.42	7	....		15 815.	3	....
	6 855.18	6	....	I	8 661.92	6	....		15 821.	3	....
	6 885.77	4	....	I	8 688.64	7	....		16 166.	2	....
	6 916.71	4	....	I	8 824.25	6	....		16 317.	2	....
	6 945.21	7	....		8 838.4	2	....		25 987.	3	....
	6 978.86	7	....		8 866.9	3	....		26 229.	2	....

Krypton

Wave length.	Geissler tube.	Wave length.	Geissler tube.	Wave length.	Geissler tube.
2 227.9	6	2 320.8	6	2 413.9	9
2 237.0	5	2 329.2	8	2 415.0	9
2 245.3	6	2 344.5	8	2 418.2	10
2 273.1	6	2 359.9	10	2 420.2	10
2 277.4	7	2 362.9	8	2 426.4	9
2 282.8	10	2 371.5	8	2 428.3	10
2 287.7	10	2 375.6	10	2 439.2	8
2 300.3	8	2 392.8	7	2 442.6	7
2 301.6	8	2 394.0	8	2 446.5	8
2 211.9	8	2 398.3	10	2 452.3	6
2 314.1	8	2 406.3	6	2 453.3	6
2 315.4	9	2 408.5	7	2 456.1	8
2 316.2	10	2 409.1	8	2 457.7	8

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

KRYPTON (Continued)

Wave length.	Geissler tube.	Wave length.	Geissler tube.	Wave length.	Geissler tube.
2 459.6	7	3 679.5	4	4 489.9	4
2 464.8	8	3 680.4	7	4 501.0	7
2 478.9	4	3 686.1	6	4 502.2	9
2 506.6	9	3 690.6	5	4 523.1	5
2 592.5	5	3 718.0	10	4 524.6	4
2 620.4	4	3 718.6	8	4 556.6	4
2 639.8	4	3 721.3	7	4 577.2	6
2 648.2	4	3 735.8	5	4 582.7	4
2 681.2	4	3 741.69	10	4 615.3	5
2 712.4	8	3 744.8	9	4 619.12	6
2 795.8	5	3 754.2	5	4 624.28	10
2 816.5	6	3 778.11	10	4 633.88	5
2 833.0	6	3 783.2	10	4 658.9	5
2 892.2	5	3 796.9	4	4 671.23	10
2 967.3	5	3 860.4	5	4 680.5	4
3 046.9	5	3 863.8	5	4 694.9	4
3 063.1	5	3 875.4	7	4 734.1	4
3 124.4	6	3 894.7	5	4 738.96	7
3 141.3	6	3 906.2	8	4 762.45	5
3 189.1	7	3 912.3	5	4 765.7	6
3 191.2	6	3 917.6	6	4 807.0	4
3 200.4	6	3 920.4	8	4 829.7	3
3 207.8	8	3 954.7	5	5 498.0	3
3 239.5	6	3 994.8	6	5 519.4	4
3 240.4	6	3 997.9	5	5 562.2	6
3 245.7	10	4 044.6	5	5 570.29 p	10
3 264.8	8	4 050.5	5	5 633.0	6
3 268.5	7	4 057.01	8	5 660.1	3
3 311.5	6	4 065.05	8	5 681.9	5
3 320.3	10	4 088.36	8	5 870.92 p	10
3 325.7	9	4 098.7	7	6 056.1	2
3 330.7	7	4 109.2	6	6 456.3	5
3 351.9	6	4 145.12	6	6 904.6	5
3 405.1	7	4 273.97	10	7 587.40	10
3 439.5	6	4 282.97	4	7 601.55	10
3 446.5	7	4 292.94	6	7 685.22	7
3 460.1	6	4 300.5	5	7 694.53	8
3 470.0	7	4 318.0	5	7 854.81	7
3 474.6	7	4 318.55	8	8 059.47	4
3 488.6	8	4 319.58	10	8 104.33	7
3 503.2	6	4 355.47	10	8 112.89	10
3 507.4	9	4 362.6	9	8 190.02	6
3 535 3	6	4 376.1	10	8 263.22	4
3 589.6	7	4 399.9	6	8 281.02	3
3 599.9	6	4 436.8	4	8 298.07	6
3 607.9	9	4 453.91	10	8 508.85	2
3 631.9	10	4 463.68	10	8 776.73	3
3 653.96	10	4 475.0	4	8 928.72	1
3 669.0	9				

LANTHANUM

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.
2 297.8	..	7	2 476.7	..	7	2 651.7	..	8
2 379.4	..	10	2 610.34	4	5	2 808.36	5	3

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

Lanthanum (Continued)

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.
3 171.7	..	10	4 383.45	6	8	5 808.32	5r	1
3 245.12	6	4	4 385.18	5	4	5 821.99	6r	1
3 249.35	5	3	4 427.56	7	8	5 823.83	4r	....
3 265.65	6	4	4 429.90	10	10	5 829.73	4r	....
3 303.11	6	5	4 452.17	6	1	5 845.03	4r	....
3 337.49	8	10	4 522.38	9	10	5 848.36	4r	....
3 344.56	8	7	4 525.29	6	8	5 855.59	4r	....
3 380.91	8	10	4 526.11	8	8	5 863.70	5r	2
3 517.1	..	10	4 549.50	6	1	5 880.63	5r	2
3 645.41	6	8	4 558.45	7	5	5 894.83	4r	....
3 650.17	5	4	4 567.90	6	1	5 930.59 P	6r	3
3 713.55	5	6	4 570.02	6	1	6 038.59	4r	....
3 715.52	5	4	4 574.85	8	5	6 068.74	4r	....
3 759.07	8	10	4 580.06	6	3	6 108.49	5r	....
3 790.82	8	10	4 613.38	6	5	6 111.74	4r	....
3 794.76	8	10	4 619.83	5	6	6 126.09	4r	3
3 840.70	5	5	4 655.49	7	10	6 129.57	5r	3
3 849.00	6	10	4 662.51	6	4	6 134.42	5r	....
3 871.63	8	10	4 663.76	5	8	6 165.73	5r	....
3 886.34	7	10	4 668.90	5	8	6 249.94 p	7r	5
3 916.03	7	10	4 671.81	4	5	6 262.29	5r	6
3 921.54	7	10	4 692.49	5	5	6 266.06	4r	1
3 929.21	8	10	4 728.41	7	3	6 293.60	4r	2
3 949.10 P	10	10	4 740.27	8	5	6 296.11	5r	5
3 988.52	10	10	4 743.08	8	10	6 320.39	5r	5
3 995.75	10	5	4 748.72	6	5	6 325.93	5r	1
4 025.87	6	4	4 809.00	6	3	6 390.48	5r	7
4 031.70	7	10	4 824.06	6	4	6 394.24	6r	6
4 042.92	8	10	4 860.90	6	3	6 399.04	5	5
4 050.09	6	10	4 899.92	7	4	6 411.00	10	3
4 067.39	6	8	4 920.98	7	5	6 454.53	6	1
4 077.35 p	10	10	4 921.80	7	5	6 456.00	5r	3
4 086.71	10	10	4 986.83	6	2	6 526.98	8	4
4 099.55	7	10	4 999.46	6	3	6 543.17	8	1
4 123.23 p	10	10	5 106.22	6	1	6 578.54	5	3
4 141.75	10	10	5 114.54	6	3	6 616.60	4	....
4 151.97	8	10	5 122.96	5	3	6 650.81	4	....
4 152.78	4	5	5 183.41	8	5	6 661.41	4	1
4 192.34	7	8	5 301.96	5	1	6 671.41	4	2
4 196.55	10	10	5 455.14 p	6	1	6 709.51	4	....
4 204.04	5	4	5 464.39	5	1	6 753.07	4	....
4 217.55	6	10	5 501.35	6r	1	6 774.28	6	3
4 230.95	4	6	5 541.26	4r	....	6 925.26	3	....
4 238.39	10	10	5 588.34	4r	....	7 066.21	5	....
4 249.99	5	6	5 648.25	5	....	7 068.34	4	....
4 263.59	6	8	5 740.65	6r	1	7 161.22	4	....
4 269.49	6	10	5 744.41	5r	....	7 282.33	5	....
4 275.64	4	4	5 761.84	5r	1	7 334.17	5	....
4 286.95	8	10	5 769.07	7r	3	7 345.34	4	....
4 296.06	9	8	5 769.35	7r	1	7 483.48	4	....
4 322.53	6	5	5 769.97	5r	.....	8 324.69	3	....
4 333.80	10	10	5 789.23	6r	1	8 346.55	3	....
4 334.97	6	8	5 791.33	7r	1	8 545.43	3	....
4 354.39	8	10	5 797.59	7r	2	8 674.38	3	....
4 378.09	7	4	5 805.76	5r	2	8 748.42	2	....

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

LEAD

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.
884.	..	5	2 059.	7r	10	3 176.5	..	10
890.	..	3	2 060.	7r	7	3 572.74	5r	10
894.	..	5	2 088.2	5r	....	3 639.58 p	6r	10r
907.	..	7	2 115.0	5r	....	3 683.47 p	3r	10r
927.	..	7	2 159.6	3r	....	3 739.95	5r	4r
954.	..	3	2 170.0 P	6r	2r	3 854.0	..	10
1 004.	..	3	2 175.6	4r	....	4 019.64	3	10
1 029.	..	10	2 203.5 P	3	4r	4 057.83 p	5r	10r
1 166.	..	7	2 237.42	3r	2r	4 062.15	3	10
1 203.	..	7	2 246.90	6r	4r	4 168.04	3	10
1 213.	..	3	2 332.47	4r	2	4 242.5	..	10
1 232.	..	7	2 393.81	5r	3r	4 245.2	..	10
1 250.	..	10	2 401.94	4r	3	4 386.	..	10
1 267.	..	7	2 411.75	4r	2	5 005.45	3	2
1 316.	..	10	2 443.86	4r	4	5 608.8	4	10
1 349.	..	3	2 446.20	4r	4	5 895.7	5	....
1 434.	..	10	2 476.39	4r	2r	6 002.	5	....
1 534.	..	7	2 577.28	6r	3r	7 228.98	6	....
1 554.	..	10	2 613.68	3r	3r	10 291.	10	....
1 660.	..	2	2 614.20	6r	5r	10 500.	10	....
1 671.	..	2	2 663.17	10r	10r	10 651.	6	....
1 682.5 p	6	2	2 802.01	5r	10r	10 888.	1	....
1 726.	6	2	2 823.20	4r	10r	10 971.	3	....
1 781.	..	2	2 833.07 p	6r	10r	12 564.	4	....
1 796.5	6	3	2 873.32	6r	10r	13 102.	4	....
1 822.	8	3	3 043.87	1	10	14 744.	3	....
1 869.	..	5	3 137.8	..	10	15 315.	3	....

LITHIUM

I 2 394.4	1r	....	I 4 148.	..	....	13 566.	2	....
2 425.6	3r	....	I 4 273.3	5	2	I 17 552.	2	....
I 2 475.	4r	....	I 4 602.0	9r	10	18 697.	5	....
I 2 562.5	5r	....	I 4 603.0	9r	10	I 19 290.	1	....
I 2 741.3	6r	2r	I 4 636.	3	....	23 991.	2	....
I 3 232.7 p	8r	3r	I 4 971.9	7	4	I 24 467.	8	....
I 3 719.	3	....	I 6 103.6	10r	10	I 26 875.	2	....
I 3 794.	5	....	I 6 240.6	1	....	26 891.	1	....
I 3 915.	2r	1	I 6 707.86 P	10r	10r	I 40 475.	1	....
I 3 935.7	3	....	I 8 126.4	10	....	I 74.360.	1	....
I 4 132.3	5	1	I 12 232.	1	....			

LUTECIUM

2 578.79	4	5	2 963.33	7	10	3 281.75	10	5
2 603.32	..	10	2 969.81	6	10	3 312.12	10	5
2 615.42	10	10	3 020.56	4	10	3 359.59	10	5
2 657.83	4	10	3 056.74	10	10	3 376.54	10	5
2 754.19	4	10	3 057.96	..	10	3 397.02 p	10	10
2 772.60	..	10	3 077.62	10	10	3 472.49 p	10	10
2 796.64	4	10	3 081.48	9	3	3 507.40	10	10
2 847.50	5	10	3 118.42	7	3	3 508.41	10	3
2 894.86 p	10	10	3 191.78	2	10	3 544.93	5	....
2 900.32	10	10	3 198.13	10	10	3 554.43 p	10	10
2 911.40 p	10	10	3 254.31	10	10	3 567.84	10	5
2 951.68	3	8	3 278.96	10	4	3 623.97	10	10

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

Lutecium (Continued)

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.
3 636.26	10	3	4 839.52	4	1	6 160.00	6	1
3 647.77	5	2	4 904.87	5	1	6 199.73	5	....
3 684.34	4	....	4 994.13	10	3	6 221.88	10	4
3 841.15	7	2	5 001.14	6	1	6 235.39	5	1
3 876.65	10	10	5 135.11	10	1	6 242.42	7	1
4 054.46	5	2	5 402.57	10	1	6 345.44	7	....
4 124.73	10	5	5 476.70	10	10	6 463.16	10	3
4 184.24	10	10	5 736.54	10	1	6 523.16	10	....
4 281.03	5	1	5 775.39	6	....	6 793.80	5	....
4 296.02	5	1	5 983.65	10	1	6 917.28	7	....
4 518.54 p	10	5	5 984.11	10	1	7 031.18	4	....
4 658.00	10	3	6 004.54	10	1	7 125.85	7	....
4 785.45	5	3	6 055.05	6	....			

Magnesium

	1 231.6	..	2	II	2 802.71 p	10r	10r	I	4 571.12	5	2
	1 320.9	..	5	I	2 846.78	4	1	I	4 703.07	10	5
	1 323.2	..	4	I	2 848.42	5	1	II	4 739.6	..	5
II	1 735.	1	6	I	2 852.13 P	10r	10r	II	4 851.1	..	5
II	1 737.	2	7		2 915.5	3	8	I	5 167.33	8r	10
	1 741.	5	....	II	2 928.7	3	10	I	5 172.68	10r	10
	1 744.	5	....	II	2 936.6	4	10r	I	5 183.60	10r	10
II	1 750.9	..	5	I	2 936.8	4	....	I	5 528.48	10	5
II	1 753.6	..	6	I	2 938.5	5	....	I	5 711.13	5	1
I	1 828.	3	....	I	2 942.06	6	2	I	6 318.5	2	....
	1 856.	5	....	I	3 091.09	8r	1	II	6 347.1	4	....
	1 864.	4	....	I	3 093.05	8r	2	I	7 658.	2	....
	1 886.	5	....	I	3 096.92	10r	2	II	7 877.1	..	4
	1 931.	6	....	II	3 104.7	..	10	II	7 896.3	..	5
I	2 026.	6	6	II	3 104.8	..	10	I	8 806.8	5	....
II	2 660.76	..	5	I	3 329.94	8	3	I	8 929.	2	....
II	2 660.82	..	5	I	3 332.17	10	5		9 224.	1	....
I	2 668.2	3	....	I	3 336.69	10	8	I	9 258.	3	....
I	2 669.7	6	....	II	3 535.0	..	5	I	10 813.	3	....
I	2 672.6	8	....	II	3 538.8	..	6	I	10 963.	1	....
I	2 693.8	2	....	I	3 829.36 p	8r	10r	I	10 970.	3	....
I	2 695.3	4	....	I	3 832.17 p	10r	10r		11 054.?	2	....
I	2 698.2	5	....	I	3 838.29	10r	10r	I	11 828.	10	....
I	2 733.55	4	1	II	3 848.2	..	7	I	12 083.	5	....
I	2 736.6	4	1	II	3 850.4	..	6	I	14 877.	10	....
I	2 776.71	6r	6r	I	4 167.6	4	1	I	15 028.	6	....
I	2 778.29	6r	6r	I	4 351.9	8	2	I	15 759.	1	....
I	2 779.85	8r	8r	II	4 384.6	..	8	I	15 768.	4	....
I	2 781.43	6r	6r	II	4 390.6	..	10	I	17 108.	6	....
	2 782.99	6r	6r	II	4 428.0	..	7	I	23 963.	1	....
II	2 790.83	4	10r	II	4 434.0	..	8	I	23 977.	1	....
II	2 795.54 P	10r	10r	II	4 481.	..	10	I	23 991.	1	....
II	2 798.0	..	10								

Manganese

311.	..	1	1 118.	..	5	1 892.0	..	4
648.	..	2	1 438.	..	5	1 904.	..	5
893.	..	10	1 573.?	..	5	1 952.1	..	3
1 113.	..	5	1 789.	..	10	1 993.	..	5

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

MANGANESE (Continued)

	Wave length.	Arc.	Spark.		Wave length.	Arc.	Spark.		Wave length.	Arc.	Spark.
II	2 452.52	2r	10	I	3 570.10	4r	3	I	4 709.70	7	2
	2 575.51	5	1	I	3 577.88	8r	5	I	4 727.46	7	2
II	2 576.12 P	5r	10r	I	3 586.55	5	5	I	4 739.00	5	2
	2 592.95	5	1	I	3 607.52	8	3	I	4 754.05	10	8
II	2 593.73 p	4r	10r	I	3 608.48	6	3	I	4 761.53	5	2
II	2 605.69 p	5r	10r	I	3 610.30	6	3	I	4 762.38	9	4
	2 618.15	4	8	I	3 806.86	6	8	I	4 765.86	5	2
	2 625.6	..	8	I	3 809.60	6	6	I	4 766.42	6	3
	2 632.35	1	8	I	3 823.51	4r	6	I	4 783.43	10	4
	2 638.17	1	5	I	3 823.90	4	4	I	4 823.52	10	4
	2 655.8	..	5	I	3 833.87	6	4		4 965.86	5	1
	2 672.58	1	5	I	3 834.36	6r	8		5 196.60	5	1
	2 695.36	1	5	I	3 839.77	4	5		5 255.33	5	2
	2 701.70	3	5	I	3 841.09	4	6	I	5 341.07	10	8
	2 705.74	2	8	I	3 843.99	6	4		5 377.63	8	3
	2 711.6	..	5		3 985.24	4	3		5 394.68	7	2
I	2 794.82	6r	5r	I	4 018.11	8	8		5 399.51	8	3
I	2 798.27	6r	5r	I	4 030.76 P	6r	10r	I	5 407.43	7	2
I	2 801.08	6r	5r	I	4 033.07 p	8r	10r		5 413.70	7	2
	2 879.49	1	5		4 033.63	3r	3	I	5 420.37	7	3
	2 886.68	2	6	I	4 034.49 p	8r	10r		5 432.56	6	1
	2 889.52	3	10	I	4 035.73	5r	8	I	5 470.64	8	2
I	2 914.61	8(2)	1	I	4 041.37	8r	10	I	5 481.40	6	1
I	2 925.59	6(2)	1		4 045.20	4	5		5 505.88	6	1
II	2 933.06	6	10	I	4 048.76	4	8	I	5 516.77	8	2
II	2 939.31	6	10	I	4 055.55	8	8	I	5 537.75	7	2
I	2 940.39	6	1	I	4 079.25	6	5		5 551.99	5	1
II	2 949.21	6	10	I	4 079.43	6	5		5 567.77	4	1
I	3 044.57	4	2	I	4 082.95	6	6		5 738.28	4	....
I	3 054.38	4	2	I	4 083.64	6	6		5 780.17	5	....
I	3 062.13	4	1		4 131.12	4	4		5 848.97	3	....
I	3 079.63	5	1		4 176.60	4	4	I	6 013.50	10	1
	3 110.69	5	1		4 189.99	4	4	I	6 016.64	10	1
I	3 148.19	4	1	I	4 235.14	8	....	I	6 021.79	10	1
I	3 178.53	8	1	I	4 235.29	8	10		6 078.40	3	....
I	3 212.89	6	2	I	4 239.73	5	5		6 382.19	3	....
	3 228.10	5	3	I	4 257.67	5	4		6 440.97	5	....
I	3 236.79	6	3	I	4 265.92	5	5		6 491.71	7	....
I	3 243.79	4	2	I	4 281.10	5	5		6 605.57	4	....
I	3 248.52	4	3		4 374.94	4	2		6 942.55	5	....
I	3 256.14	4	2	I	4 414.87	8	6		6 989.94	4	....
I	3 258.42	4	2	I	4 436.36	7	5		7 069.86	4	....
	3 317.30	6n	1	I	4 451.59	9	3		7 151.33	8	....
	3 320.70	4	1	I	4 453.01	5	3		7 184.29	5	....
	3 330.67	4	3	I	4 455.02	6	3		7 247.83	5	....
I	3 442.00	5	10	I	4 455.32	6	3		7 283.30	6	....
I	3 460.33	3	10	I	4 455.82	5	3		7 302.92	6	....
I	3 474.14	4	10	I	4 457.04	5	2		7 326.55	7	....
I	3 482.92	4	10	I	4 457.55	6	4		7 646.34	3	....
I	3 488.69	4	10	I	4 458.27	6	5		7 680.20	5	....
I	3 495.84	5	6	I	4 461.09	6	4		7 710.2	5	....
I	3 531.84	4r	2	I	4 462.03	9	8		7 712.4	5	....
I	3 532.00	5r	3	I	4 464.68	7	5		7 764.8	5	....
I	3 532.11	5r	3	I	4 470.14	7	4		7 821.3	2	....
I	3 547.79	5r	4	I	4 472.80	7	3		7 942.9	2	....
I	3 548.02	4r	3	I	4 490.09	5	3		8 212.4	2	....
I	3 548.19	4r	3	I	4 498.90	7	4		8 654.6	2	....
I	3 569.50	6r	5	I	4 502.22	7	4	I	8 670.8	2	....
I	3 569.80	8r	4		4 626.54	5	2	I	8 672.1	2	....

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

Manganese (Continued)

	Wave length.	Arc.	Spark.		Wave length.	Arc.	Spark.		Wave length.	Arc.	Spark.
I	8 703.7	3	....	I	13 294.	5	....	I	13 997.	10	....
I	8 740.9	3	....	I	13 318.	3	....		14 970.	3	....
	11 378.	2	....		13 416.	8	....		15 218.	8	....
	11 614.	4	....		13 500.	10	....		15 263.	10	....
	11 782.	6	....	I	13 626.	10	....		15 965.	10	....
	12 307.?	..	....		13 685.	8	....		17 336.	8	....
I	12 900.	8	....	I	13 864.	10	....		17 608.	2	....
	12 976.	4	....								

Mercury

I	1 269.7	..	5	I	3 021.50	5	4	I	6 072.63	5	....
	1 527.	..	5	I	3 125.6	8	8r		6 123.47	6	....
	1 592.	..	8	I	3 131.56	7	5r	I	6 234.35	8	....
	1 599.	..	7	I	3 131.84	7	4r	I	6 907.5	10	....
II	1 650. p	..	10	I	3 341.48	6	5	I	7 082.0	4	....
	1 677.9	..	10	I	3 650.15	10	9r		7 729.2	6	....
	1 738.3	..	8	I	3 654.83 p	7	5	I	10 140.	10	....
	1 798.7	..	9	I	3 662.87	4	4	I	11 287.	9	....
I	1 849. P	10	10	I	3 663.27	6	5	I	11 888.	1	....
II	1 942. p	10	5	I	3 906.4	6	....	I	13 570.	6	....
II	2 224.7	4	4		3 983.99	6	8	I	13 673.	8	....
I	2 378.3	3	....	I	4 046.56	10	10r	I	13 950.	4	....
I	2 399.4	3	....	I	4 077.8	7	5r		15 295.	5	....
I	2 482.7	3	....	I	4 339.23	6	1	I	16 921.	2(2)	....
I	2 534.8	4	2	I	4 347.50	6	1	I	17 073.	2	....
I	2 536. P	10r	10r	I	4 358.34	10	10r	I	17 110.	2	....
I	2 652.0	5	2	I	4 916.0	5	1		18 333.	1	....
	2 698.9	3	....		4 960.3	5	....		19 701.	1(2)	....
I	2 752.8	4	4	I	5 460.73	10r	10r	I	23 253.	1	....
I	2 803.5	4	....	I	5 675.8	5	....		36 492.	2	....
II	2 847.7	..	8	I	5 769.60	10	5	I	39 425.	10	....
I	2 893.6	5	5	I	5 790.66	10	5		40 159.	8	....
I	2 967.28	5	8r								

Molybdenum

	1 377.	..	1	II	2 911.91	5	10		3 504.41	6	2
	1 548.	..	4	II	2 923.40	4	10		3 524.62	2	7
	1 692.	..	2		3 087.61	2	10		3 614.25	8	3
	1 697.	..	4		3 116.08	1	8		3 635.15	2	10
	1 809.8	..	7		3 121.99	2	10		3 651.14	1	8
	2 538.46	2	10	I	3 132.60	10r	2	II	3 688.33	1	10
II	2 638.75	3	10		3 158.16	9r	2	II	3 692.66	2	9
II	2 644.33	2	10	I	3 170.35	10r	2	II	3 702.56	2	8
II	2 660.58	2	10	I	3 193.98	10r	2	I	3 798.26 P	10r	10r
	2 672.84	2	10		3 208.85	10	2		3 833.76	7	3
II	2 684.13	3	10		3 292.32	1	10	I	3 864.12 p	10r	10
II	2 701.42	2	10		3 325.67	10	1	I	3 902.96 p	10r	10
	2 775.40	3	10	I	3 327.30	10	1	II	3 941.50	1	10
	2 780.04	3	10		3 344.75	8	2		3 961.49	3	10
II	2 816.15 P	5	10		3 347.02	6	1		4 069.91	9	8
II	2 848.21 p	5	10	I	3 358.12	9	2		4 084.39	8	3
	2 853.19	1	10	I	3 384.62	8	2	I	4 102.16	7	3
II	2 871.50 p	4	10		3 402.81	1	8		4 143.56	9	5
	2 903.07	2	10		3 447.13	10	3		4 185.82	8	4

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

Molybdenum (Continued)

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.
4 188.32	10	5	4 731.45	10	7	6 357.21	5	3
4 232.61	10	5	4 760.20	9	9	6 424.37	8	8
4 250.69	1	10	4 819.26	10	4	6 519.84	4	3
4 251.86	10r	2	4 830.52	10	4	I 6 619.15	9	8
4 276.92	10	5	4 868.03	5	2	6 650.38	7	1
I 4 277.26	10	6	4 979.12	5	2	I 6 733.99	7	1
II 4 279.03	2	10	I 5 172.94	9	1	6 746 28	5	1
I 4 292.21	9	4	I 5 174.15	9	2	6 838.95	4	....
I 4 293.24	10	4	I 5 238.20	7	3	6 886.37	4	....
I 4 293.89	9	3	I 5 240.94	6	3	6 914.05	5	....
4 326.14	9	4	I 5 360.59	10	8	6 989.01	4	....
II 4 363.65	1	10	5 473.35	6	6	I 7 060.23	4	....
II 4 377.76	1	10	I 5 506.50	10	10	I 7 109.87	8	....
4 381.65	10	8	I 5 533.03	10	10	I 7 134.09	4	....
4 411.71	10	8	I 5 570.46	10	10	I 7 242.54	7	....
II 4 433.51	1	8	I 5 632.47	9	8	7 245.87	4	....
4 434.96	10	4	I 5 650.13	8	6	I 7 391.36	5	....
4 468.27	10	2	I 5 689.15	9	10	I 7 485.73	7	....
4 491.29	6	2	I 5 722.77	8	7	I 7 658.74	5	....
I 4 524.34	7	2	I 5 751.42	10	10	7 720.74	4	....
I 4 576.49	8	2	I 5 791.84	10	10	I 8 245.06	3	....
I 4 595.15	7	2	I 5 858.28	8	10	I 8 328.43	5	....
4 621.35	7	2	I 5 888.32	10	10	I 8 389.28	6	....
I 4 626.45	10	4	I 5 928.82	9	10	8 695.53	2	....
4 707.25	10	5	I 6 030.66	9	10	9 348.01	2	....

Neodymium

3 092.91	4	2	4 061.09	10	10	4 811.33	5	5
3 133.56	4	2	4 069.26	5	4	4 825.47	8	8
3 217.10	4	1	4 075.24	7	2	4 859.01	5	5
3 275.20	4	2	4 109.09	8	6	4 920.66	9	3
3 300.14	4	2	4 109.47	9	8	5 192.62	6	3
3 328.26	5	2	4 135.33	9	7	5 249.54	7	4
3 388.01	5	1	4 156.16	10	10	5 293.17	9	5
3 410.21	4	1	4 177.34 p	9	10	5 319.80	9	4
3 543.33	5	2	4 178.68	6	3	5 361.47	5	4
3 592.58	5	2	4 232.40	8	5	5 431.53	4	3
3 609.78	5	1	4 247.37	10	8	5 485.68	7	4
3 653.10	6	2	4 282.51	10	8	5 594.40	8	5
3 735.59	7	5	4 303.61 p	10	10	5 620.58	8	5
3 780.40	5	3	4 314.50	7	8	5 688.49	6	3
3 851.73	8	5	4 325.77	10	5	5 708.25	5	2
3 863.37	10	8	4 327.93	7	5	5 729.28	4	....
3 875.85	6	2	4 351.23	9	8	5 804.00	5	2
3 889.95	6	3	4 358.20	9	8	6 007.63	4	....
3 890.59	6	4	4 375.00	10	6	6 066.05	4	....
3 890.96	7	4	4 385.68	10	8	6 071.70	4	....
3 892.06	6	4	4 400.84	10	5	6 073.97	4	....
3 894.65	6	3	4 411.03	8	5	6 178.55	4	1
3 900.25	6	6	4 446.37	10	10	6 310.48	7	1
3 905.90	7	4	4 451.55	10	10	6 341.48	7	2
3 941.53	7	8	4 462.96	10	10	6 385.18	8	3
3 951.15 p	9	8	4 501.82	7	5	6 485.69	4	1
3 968.12	7	6	4 541.25	5	5	6 630.16	4	....
3 990.13	9	6	4 563.21	6	5	6 650.56	4	1
3 994.70	8	5	4 579.30	5	4	6 655.67	4	....
4 012.28	9	10	4 634.21	5	3	6 740.10	4	....
4 021.76	7	3	4 706.54	7	4	6 790.42	4	....

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

Neodymium (Continued)

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.
6 803.98	4	....	7 511.15	4	....	7 965.69	4	....
6 846.74	5	....	7 513.77	4	....	7 982.34	4	....
7 037.34	4	....	7 529.03	4	....	8 000.75	4	....
7 066.90	4	....	7 538.27	4	....	8 043.33	4	....
7 129.36	4	....	7 696.60	4	....	8 141.72	4	....
7 189.41	4	....	7 808.53	4	....	8 143.29	4	....
7 418.18	4	....	7 862.84	4	....	8 375.23	3	....
7 448.73	4	....	7 958.93	4	....	8 456.80	3	....

Neon

Wave length.	Geissler tube.	Wave length.	Geissler tube.	Wave length.	Geissler tube.
2 595.21	6	3 600.16	6	4 790.22	8
2 645.51	6	3 609.17	5	4 810.07	5
2 645.70	5	3 633.66	6	4 817.64	6
2 647.42	8	3 664.3	7	4 818.79	5
2 651.01	6	3 682.23	7	4 821.93	6
2 675.24	6	3 685.73	7	4 827.34	8
2 675.64	6	3 694.4	9	4 827.59	6
2 795.10	5	3 701.22	7	4 837.31	7
2 872.66	5	3 713.3	9	4 884.91	8
2 913.17	6	3 727.3	6	4 892.08	7
2 932.72	5	4 422.52	6	4 955.38	5
2 947.30	6	4 424.81	6	4 957.03	8
2 974.71	7	4 425.42	5	4 957.12	5
2 982.66	7	4 483.19	5	4 994.92	5
2 992.42	6	4 488.09	6	5 005.15	8
2 992.44	6	4 536.31	5	5 031.34	7
3 057.39	7	4 537.68	6	5 037.74	8
3 063.69	6	4 537.76	10	5 080.38	6
3 076.97	6	4 538.31	6	5 113.66	5
3 078.87	5	4 540.38	8	5 116.49	6
3 079.18	5	4 575.06	6	5 122.25	6
3 126.19	6	4 575.86	10	5 122.34	6
3 148.60	5	4 582.05	5	5 144.93	8
3 335.1	7	4 582.45	5	5 145.01	8
3 355.2	6	4 609.91	7	5 151.96	5
3 369.81	8	4 628.30	7	5 188.61	6
3 369.91	10	4 645.41	6	5 193.12	6
3 417.90	8	4 656.38	6	5 193.23	6
3 447.70	7	4 661.09	5	5 203.90	6
3 454.20	6	4 678.21	6	5 208.87	5
3 460.52	5	4 679.13	5	5 298.20	6
3 464.34	5	4 702.53	5	5 301.77	5
3 466.58	6	4 704.39	10	5 326.41	5
3 472.57	8	4 708.86	10	5 330.78	10
3 498.06	5	4 710.06	8	5 341.10	10
3 501.21	6	4 712.06	8	5 343.29	9
3 515.19	6	4 715.34	10	5 349.21	6
3 520.47	10	4 749.56	6	5 355.18	6
3 568.7	8	4 752.73	8	5 355.40	6
3 574.9	6	4 758.72	5	5 358.02	10
3 593.52	8	4 780.34	6	5 360.02	6
3 593.63	7	4 788.93	10	5 372.31	5

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

NEON (Continued)

Wave length.	Geissler tube.	Wave length.	Geissler tube	Wave length.	Geissler tube.
5 400.56 p	10	5 974.64	9	6 678.28	8
5 412.66	7	5 975.53	8	6 717.04	5
5 418.56	6	5 987.93	7	6 929.47	9
5 433.65	7	5 991.68	6	7 024.05	6
5 448.51	6	6 000.95	5	7 032.41	6
5 533.68	5	6 030.00	7	7 051.30	4
5 562.44	6	6 074.34	9	7 059.12	4
5 562.76	8	6 096.16	8	7 173.94	10
5 563.05	5	6 128.45	6	7 245.17	10
5 652.57	5	6 142.51	5	7 438.89	8
5 656.03	5	6 143.06	10	7 472.46	6
5 656.66	8	6 150.27	5	7 488.89	5
5 662.55	6	6 163.60	8	7 535.78	8
5 689.81	7	6 182.15	5	7 544.05	8
5 718.90	7	6 205.76	5	7 943.19	8
5 719.22	9	6 213.88	6	8 082.46	8
5 719.53	6	6 217.28	9	8 136.41	4
5 748.29	9	6 246.71	5	8 236.42	7
5 748.65	6	6 258.78	5	8 259.36	4
5 764.42	9	6 266.50	10	8 266.02	5
5 804.10	6	6 293.7	5	8 300.35	7
5 804.45	9	6 304.79	5	8 377.62	7
5 811.42	7	6 313.65	6	8 418.41	7
5 820.17	9	6 328.15	7	8 495.37	7
5 828.91	6	5 330.89	6	8 591.25	6
5 852.49	10	6 334.43	9	8 634.63	5
5 868.4	5	6 351.8	5	8 654.38	6
5 872.17	5	6 364.96	5	8 679.52	3
5 872.84	9	6 382.99	10	8 681.86	3
5 881.90	10	6 401.08	5	8 780.63	4
5 902.48	5	6 402.25 p	10	8 783.75	4
5 906.44	5	6 409.71	6	8 853.97	3
5 913.63	7	6 421.68	5	8 865.72	3
5 918.92	7	6 444.70	6	9 148.72	2
5 939.32	5	6 506.53	10	9 201.88	2
5 944.83	9	6 532.88	5	9 220.28	2
5 961.63	5	6 598.95	8	9 300.70	2
5 965.44	10				

NICKEL

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark
1 398.	..	2	2 029.1	..	6	I 2 798.66	4	1
1 499.	..	2	I 2 310.99	3r	2	I 2 821.30	4	2
1 527.	..	2	I 2 312.36	3r	1	I 2 943.92	6	2
1 653.	..	6	I 2 320.08	5r	1	I 2 981.65	7	3
1 693.	..	7	I 2 325.81	3r	2	I 2 992.60	6	2
1 709.	..	6	I 2 345.53	2r	8r	I 2 994.46	7r	3
1 767.	..	6	2 375.43	1	8	I 3 002.49	10r	5
1 855.	..	5	2 394.56	2	10	I 3 003.63	9r	4
1 929.7	..	5	2 416.14	1	10	I 3 012.01	9r	5
1 979.3	..	6	2 437.90	1	10	I 3 037.94	9r	4
2 019.0	..	6	2 510.89	4	10	I 3 050.83	10r	6
2 021.0	..	6	2 545.92	1	6	I 3 054.32	8r	4

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

NICKEL (Continued)

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.
I 3 057.65	10r	4	I 4 592.54	9	4	I 6 339.17	10	...
I 3 064.63	6	2	I 4 600.37	8	1	I 6 378.22	7	...
I 3 080.76	6	2	I 4 604.99	9	3	I 6 384.69	7	...
I 3 097.12	5	2	I 4 648.66	10	3	6 421.47	7	...
I 3 101.56	9r	4	I 4 686.21	5	3	I 6 482.84	7	1
I 3 101.88	9r	3	I 4 714.42	10	8	I 6 586.33	6	...
I 3 134.10	10r	4	I 4 715.76	8	3	I 6 598.54	6	...
I 3 197.12	5	2	I 4 756.53	7	3	6 635.14	6	...
I 3 221.66	4r	2	I 4 786.54	10	3	I 6 643.66	10	1
I 3 225.03	5r	2	I 4 829.03	8	3	I 6 767.79	10	...
I 3 232.94	8r	3	I 4 831.19	5	3	I 6 772.36	9	...
I 3 234.66	5r	2	I 4 855.42	8	3	I 6 842.08	6	...
I 3 243.06	8r	3	I 4 866.28	7	2	I 6 914.58	7	...
I 3 315.67	7r	3	4 904.42	9	3	I 7 024.76	8	...
I 3 320.26	5r	3	4 980.17	9	2	I 7 122.29	10	...
I 3 361.56	5r	3	I 4 984.12	9	2	I 7 182.06	9	...
I 3 365.77	4r	3	I 5 017.59	7	2	I 7 197.07	4	...
I 3 366.17	5r	3	I 5 035.36	10	3	I 7 261.94	8	...
I 3 369.57	10r	4	5 080.53	8	3	I 7 291.30	8	...
I 3 371.99	5r	3	5 081.12	9	3	7 385.23	7	...
I 3 374.22	4r	2	5 084.07	6	1	7 386.24	7	...
I 3 380.58	10r	6	I 5 099.97	7	1	I 7 393.67	10	...
I 3 380.88	4r	2	I 5 115.42	9	2	I 7 409.35	9	...
I 3 391.05	7r	4	I 5 125.20	7	....	I 7 414.51	6	...
I 3 392.99	10r	8	I 5 129.38	8	1	I 7 422.34	9	...
I 3 413.48	5r	3	I 5 137.09	8	1	I 7 481.49	5	...
I 3 413.94	3r	2	I 5 142.76	10	2	I 7 522.87	8	...
I 3 414.77 P	10r	10	I 5 146.48	10	2	I 7 525.18	8	...
I 3 423.71	8r	5	I 5 155.76	9	1	I 7 555.67	9	...
I 3 433.57	9r	6	I 5 168.66	8	1	I 7 574.10	7	...
I 3 437.28	6r	5	5 176.55	6	1	I 7 617.02	10	...
I 3 446.26	10r	10	5 411.20	6	1	I 7 619.24	9	...
I 3 452.89	6r	5	I 5 435.87	7	1	I 7 714.27	8	...
I 3 458.47	10r	10	I 5 476.91	10	10	I 7 715.64	7	...
I 3 461.66	10r	10	I 5 592.24	7	2	I 7 727.68	10	...
I 3 472.55	7r	5	I 5 593.74	6	1	7 748.94	10	...
I 3 483.78	6r	4	I 5 614.79	6	1	I 7 788.95	6	...
I 3 492.96 p	10r	10	5 625.28	7	1	I 7 797.66	8	...
3 500.85	6	4	5 682.20	7	1	I 7 863.70	5	...
I 3 510.34	7r	10	5 694.97	7	1	I 7 917.47	7	...
I 3 515.06 p	9r	10	I 5 709.55	8	2	I 8 862.60	4	...
I 3 524.54 p	10r	10	I 5 715.09	8	1	9 106.33	3	...
I 3 566.38	10r	10	I 5 754.67	6	1	I 9 519.99	2	...
I 3 571.87	7r	3	I 5 760.84	6	1	10 195.	5	...
I 3 597.70	8r	6	I 5 805.20	10	....	10 301.	3	...
I 3 610.47	9	4	5 831.60	8	....	10 330.	3	...
I 3 619.39	10	10	I 5 857.76	10	1	10 378.	4	...
I 3 674.13	6	3	I 5 892.88	9	1	10 980.	5	...
I 3 722.48	6	1	I 6 086.34	10	1	11 198.	4	...
I 3 736.81	6	3	I 6 108.14	7	1	11 591.	3	...
I 3 775.57	8	5	I 6 116.16	9	1	13 553.	2	...
I 3 783.53	8	5	6 163.36	8	1	13 722.	5	...
I 3 807.14	8	8	I 6 175.44	10	1	13 829.	3	...
I 3 831.69	6	2	6 176.80	10	2	13 969.	2	...
I 3 858.33	10	8	I 6 186.77	7	....	14 102.	2	...
I 4 401.55	10	8	I 6 191.23	7	1	14 874.	3	...
I 4 459.04	9	8	I 6 223.97	6	....	16 313.	2	...
I 4 462.46	8	3	I 6 256.39	7	1	16 363.	10	...
I 4 470.48	9	3	I 6 314.66	10	....	16 409.?	5	...

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

Nickel (Continued)

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.
16 495.	2	....	16 999.	6	....	18 040.	2	....
16 868.	2	....	17 986.	2	....			

Nitrogen

Wave length.	Geissler tube.	Wave length.	Geissler tube.	Wave length.	Geissler tube.
III 685.5	5(4)	4 176.1	5	II 5 010.6	3
II 916.82	2(4)	4 179.7	3	II 5 015.4	3
IV 922.02	.....	III 4 195.7	3	II 5 025.6	3
IV 922.57	.....	4 200.0	5	II 5 045.0	6
IV 923.18	.....	4 206.5	4	5 179.5	4
IV 923.68	.....	I 4 223.09	5	I 5 328.67	5
IV 924.31	.....	II 4 227.7	4	5 462.7	3
III 989.90 p	2	II 4 236.9	8	II 5 495.9	6
III 991.66 p	3	4 241.8	8	5 530.2	4
1 085.	10(4)	I 4 305.46	6	5 535.2	6
1 184.1	10	I 4 358.29	7	5 543.4	3
1 200.4 p	10	III 4 379.0	8	II 5 666.5 p	10
V 1 242.2	4	4 432.6	5	II 5 675.9 p	5
II 1 276.0	10(3)	4 447.0	10	II 5 679.5 p	10
1 335.3	10	I 4 492.45	5	II 5 686.2	5
I 1 492.83	3	I 4 494.68	5	II 5 931.9	4
I 1 494.78	3	III 4 510.8	4	II 5 941.9	7
1 561.1	7	III 4 514.8	4	I 5 999.46	5
1 657.2	7	4 530.0	6	I 6 008.49	9
I 1 742.81	5	4 552.4	4	I 6 441.70	5
I 1 745.31	5	II 4 601.5	7	I 6 482.74	9
II 3 006.8	7	II 4 607.1	7	I 6 483.77	4
II 3 329.2	3	II 4 613.9	6	I 6 484.88	8
II 3 437.1	7	II 4 621.4	7	6 610.	4
I 3 650.1	5	II 4 630.5	8	I 6 644.97	7
I 3 822.0	5	III 4 634.1	6	I 6 722.60	5
II 3 830.0	6	III 4 640.6	6	I 7 423.88	3
3 839.0	4	II 4 643.0	9	I 7 442.56	4
II 3 842.8	3	II 4 654.5	3	I 7 468.74	5
II 3 856.1	3	4 667.2	3	8 185.05	3
3 870.0	4	II 4 774.2	3	8 188.16	3
3 919.0	6	II 4 779.8	3	8 200.59	1
3 940.0	3	II 4 788.2	4	8 210.94	2
II 3 955.8	7	II 4 793.8	3	8 216.46	5
II 3 995.0	10	II 4 803.3	5	8 223.28	3
4 026.0	4	II 4 810.3	3	8 242.47	3
II 4 035.0	5	III 4 858.82	3	8 568.04	1
4 041.3	7	III 4 867.14	4	8 594.34	1
II 4 043.5	3	4 895.3	3	8 629.61	2
III 4 097.3 p	10	I 4 914.92	4	8 680.35	2
III 4 103.4 p	7	I 4 935.03	9	8 683.61	2
I 4 109.94 P	10	4 987.3	4	8 686.33	1
4 133.6	3	4 994.4	4	8 703.42	1
4 145.8	4	II 5 001.34	7	8 711.87	1
I 4 151.44	9	5 005.1	6	8 718.99	1
4 171.6	4	5 007.4	3	8 729.07	1

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

Osmium

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.
2 909.08	7	5	3 857.09	10	....	5 149.73	7	....
3 058.66	7	4	3 876.80	7	3	5 416.33	10	....
3 156.25	7	3	3 963.63	10	3	5 523.56	10	....
3 232.05	6	3	3 977.24	10	3	5 584.43	10	....
3 267.94 p	8	3	4 066.71	10	3	5 721.94	10	....
3 301.56 p	9	2	4 091.83	9	2	5 780.81	10	....
3 370.60	7	2	4 112.03	10	4	5 857.57	10	....
3 528.60	9	3	4 135.80	10	5	5 995.99	10	....
3 559.82	9	3	4 172.55	6	1	6 227.74	10	....
3 560.88	9	4	4 173.24	9	2	6 403.18	8	....
3 598.11	9	2	4 175.62	7	2	6 576.81	6	....
3 656.90	7	1	4 260.85	10	5	6 729.54	9	....
3 670.90	7	2	4 293.95	8	3	6 806.61	7	....
3 719.50	10	2	4 311.39	10	3	6 955.96	8	....
3 720.13	10	2	4 394.87	8	3	7 060.62	6	....
3 752.7 p	10	7	4 420.46	10	10	7 145.50	8	....
3 782.20 p	10	4	4 550.40	6	3	7 148.89	6	....
3 790.12	9	3	4 616.78	10	2	7 253.52	5	....
3 793.90	10	3	4 631.83	10	2	7 407.97	4	....
3 836.03	10	2	4 794.00	10	3	7 602.96	6	....
3 840.29	10	1	4 865.61	10	....	7 852.18	3	....
3 849.96	10	....						

Oxygen

	136.6	..	0	III	832.93	..	7		1 085.2	..	10
	305.7	..	3	II	833.33	..	9		1 128.4	..	5
	374.3	..	4	III	833.74	..	8		1 132.3	..	10
III	507.38	..	4	II	834.46	..	10		1 134.8	..	10(2)
III	507.68	..	5	III	835.09	..	3		1 152.6	..	6
III	508.18	..	6	III	835.29	..	9		1 175.6	..	10
III	525.79	..	6		889.7	..	8		1 200.	..	10(3)
IV	553.33	..	5		904.7	..	10		1 217.62	..	10
IV	554.07	..	5		916.4	..	15		1 247.7	..	10(3)
IV	554.52	..	5		917.8	..	15		1 277.	..	5
IV	555.23	..	5	I	948.7	4	....	I	1 302.3 p	10	....
	580.41	..	3	I	950.2	4	....	I	1 305.0 p	10	....
	580.98	..	4	I	950.9	4	....	I	1 306.1 p	10	....
II	616.31	..	5	I	952.4	4	....	I	1 355.7	8	....
II	617.06	..	5	I	953.0	2	....	I	1 358.7	5	....
II	644.16	..	6	I	971.76	8	8		1 743.1	..	5
II	672.91	..	5	I	973.26	5	5		1 760.9	..	8
II	673.75	..	5	I	973.92	4	4		1 781.4	..	7
III	702.33	..	6	I	976.50	5	5		1 787.0	..	7
III	702.82	..	6	I	978.00	5	5	II	1 961.60	..	3(3)
III	702.90	..	6	I	978.62	4	4	II	2 182.72	..	4
III	703.85	..	7		990.	..	10(2)		2 435.2	..	6
II	718.50	..	7		991.5	..	10(2)		2 478.5	..	6
II	718.57	..	7		1 010.5	..	10		2 506.8	..	5
V	758.69	..	4	I	1 026.0	9	5		2 514.3	..	4
V	759.45	..	4	I	1 027.5	8	....		2 516.1	..	7
V	760.23	..	3	I	1 028.2	7	....		2 524.1	..	4
V	760.46	..	5		1 036.9	..	7		2 528.6	..	5
V	761.13	..	4	I	1 039.26	8	8		2 631.3	..	4
V	762.00	..	4	I	1 041.0	8	8		2 881.5	..	8
II	796.61	..	6	I	1 041.71	5	7	I	2 883.84	6	....
II	832.76	..	8		1 066.3	..	5	I	3 692.44	7	....

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

Oxygen (Continued)

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.
3 712.7	..	4	4 349.44	..	7	I 5 328.97	6	....
3 727.36	..	5	4 351.28	..	7	I 5 329.58	7	....
3 754.72	..	4	4 366.91	..	6	I 5 330.65	10	....
3 759.86	..	5	I 4 368.30	10	....	I 5 435.16	5	....
I 3 823.56	7	....	4 414.89	..	10	I 5 435.76	6	....
I 3 825.07	6	....	4 416.97	..	9	I 5 436.83	8	....
3 882.2	..	5	4 448.3	..	4	I 5 950.60	5	....
3 911.95	..	5	4 590.98	..	8	I 5 958.53	6	....
3 945.03	..	5	4 596.19	..	7	I 6 046.34	7	....
I 3 947.29	10	....	4 638.87	..	5	6 105.	..	5
I 3 947.48	7	....	4 641.83	..	8	6 115.	..	5
I 3 947.58	4	....	4 649.15	..	9	I 6 155.99	7	....
3 954.37	..	7	4 650.85	..	5	I 6 156.78	8	....
3 973.27	..	7	I 4 655.36	4	....	I 6 158.21	10	....
3 982.73	..	6	4 661.65	..	5	6 265.	..	5
4 069.90	..	9	4 676.25	..	5	I 6 453.69	6	....
4 072.16	..	10	4 699.0	..	5	I 6 454.55	7	....
4 075.87	..	10	4 705.2	..	6	I 6 456.08	9	....
4 085.2	..	5	4 751.5	..	4	6 549.	..	5
4 089.3	..	5	I 4 772.54	3	....	6 641.3	..	4
4 092.9	..	4	I 4 772.89	4	....	6 654.7	..	4
4 097.	..	4	I 4 773.36	5	....	I 7 002.22	4	....
4 105.00	..	6	I 4 803.00	4	....	7 157.3	..	10
4 119.22	..	8	4 857.0	..	4	I 7 771.97 p	10	....
4 120.27	..	6	II 4 906.88	..	5	I 7 774.20 p	8	....
4 132.99	..	5	II 4 924.60	..	6	I 7 775.42 p	6	....
4 153.31	..	6	4 941.0	..	4	I? 7 947.7	..	6
4 185.45	..	8	4 943.2	..	6	I? 7 950.8	..	5
4 189.79	..	8	I 4 967.40	4	....	I? 7 952.3	..	5
I 4 217.09	4	....	I 4 967.86	5	....	I 8 446.37	..	....
I 4 222.78	5	....	I 4 968.76	6	....	I 8 446.77	..	....
I 4 233.32	7	....	I 5 018.78	3	....	I 9 263.9	7	....
4 254.1	..	4	I 5 019.34	4	....	I 11 287.	4	....
4 317.16	..	6	I 5 020.13	5	....	I 11 294.	2	....
4 319.65	..	6	I 5 146.06	5	....	I 11 300.	2	....
4 345.57	..	6	I 5 299.00	5	....	I 13 163.	1	....
4 347.43	..	5						

Palladium

[1 596.8	..	5	II 2 505.72 p	2	10	I 3 302.14	6r	10
[1 625.8	..	5	2 551.78	1	10	I 3 373.00	6r	10
[1 667.6	..	7	II 2 565.51	1	10	I 3 404.59 P	10r	10
[1 693.4	..	6	II 2 628.24	1	10	I 3 421.23 p	8r	10
[1 704.3	..	8	2 635.92	2	10	I 3 433.44	5r	10
[1 741.0	..	6	2 658.74 p	2	10	I 3 441.41	6r	10
[1 781.8	..	6	I 2 763.09	8r	6	3 451.36	..	10
[2 367.96	1	10	2 776.87	..	10	I 3 460.75	7r	10
2 372.16	2	10	2 787.94	..	10	I 3 481.16	7r	10
2 418.73	1	10	2 854.60 p	2	10	I 3 489.78	4r	10
2 426.87	1	10	I 2 922.51	7r	3	I 3 516.95 p	8r	10
2 433.11	2	10	2 980.66	1	10	I 3 553.09	7r	10
2 446.18	1	10	I 3 027.92	4r	6	I 3 571.17	5r	10
2 447.92	10r	8	I 3 065.31	4r	4	I 3 609.55 p	9r	10
2 476 43	10r	2	I 3 114.05	5r	8	I 3 634.68 p	10r	10
2 486.53	1	10	I 3 242.71	10r	10	I 3 690.37	6r	10
2 488.92 p	4	10	I 3 251.64	5r	6	I 3 718.91	4r	10
2 498.79 p	3	10	I 3 258.78	6r	8	I 3 799.20	5r	8

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

Palladium (Continued)

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.
I 3 832.32	10	10	I 5 395.26	10	....	I 6 833.42	8	...
I 3 894.21	6r	10	I 5 542.79	10	1	I 6 916.56	9	...
I 3 958.65	5r	10	I 5 670.04	10	1	7 194.11	6	...
I 4 212.98	6r	10	I 5 695.08	9	1	I 7 368.14	10	...
I 4 473.61	7	4	I 5 739.66	4	....	I 7 486.93	7	...
I 4 788.20	8	2	I 6 130.60	8	....	I 7 763.99	10	...
I 4 817.52	9	2	I 6 508.4	6	....	I 7 915.89	7	...
I 5 163.80	10	1	I 6 774.6	6	....	I 8 132.85	6	...
5 295.60	10	2	I 6 784.6	10	1			

Phosphorus

Wave length.	Arc.	Spark.	Geissler tube.	Wave length.	Arc.	Spark.	Geissler tube.
IV 823.21	..	5	.....	I 2 553.31	3	5	....
IV 824.76	..	6	.....	I 2 554.95	3	4	1
IV 827.95	..	6	.....	2 644.2	..	1	5
III 859.69	..	6	.....	IV 2 725.67	..	4	4
V 865.48	..	4	.....	IV 2 739.3	..	2	5
V 871.42	..	5	.....	III 2 884.75	..	5	....
III 913.99	..	4	.....	III 2 896.17	..	5	5
III 917.14	..	5	.....	V 3 176.06	..	5	5
III 918.69	..	5	.....	III 3 220.23	..	6	....
III 921.86	..	5	.....	III 3 234.54	..	6	6
III 998.03	..	5	.....	IV 3 347.7	..	6	6
III 1 003.64	..	5	.....	IV 3 364.4	..	6	6
IV 1 035.54	..	4	.....	IV 3 371.1	..	5	5
V 1 118.02	..	10	.....	I 3 424.91	1	3	6
V 1 128.04	..	10	.....	3 556.5	..	2	6
1 671.5	..	....	3	3 706.1	..	6	7
1 685.8	..	....	5	3 827.4	..	3	7
1 693.8	..	....	4	3 978.3	..	6	8
1 774.8 p	..	....	7	III 4 060.41	..	6	6
1 782.7 p	..	....	7	III 4 081.18	..	7	7
1 787.5 p	..	....	6	4 178.4	..	5	8
1 834.5	..	....	4	III 4 223.34	..	7	7
I 1 846.8	..	....	7	III 4 247.87	..	7	7
I 1 851.11	6	....	6	4 385.3	..	2	6
I 1 859.36	6	....	6	4 479.7	..	2	5
I 2 023.98	7	....	7	4 587.9	..	5	8
I 2 024.98	6	....	6	4 602.0	..	5	8
I 2 032.98	6	....	6	4 727.5	..	....	6
I 2 034.02	7	....	7	4 943.4	..	2	7
I 2 136.10	6	....	6	5 253.5	..	5	8
I 2 136.79 p	8	....	8	5 296.1	..	4	8
I 2 149.81 p	8	....	8	5 425.9	..	7	7
I 2 153.63	6	....	6	5 499.7	..	3	7
I 2 154.77	7	....	7	5 676.9	..	....	5
I 2 533.98	2	4	.....	III 6 024.14	..	....	8
I 2 535.62	4	5	.....	III 6 043.05	..	....	9

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

Platinum

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.
390.	..	1	2 467.44	6r	2	3 628.11	10	4
696.	..	3	2 487.18	4r	2	3 672.00	8	3
702.	..	3	2 628.05	7r	5	3 922.98	8	10
714.	..	3	2 646.89	6r	4	4 118.69	10	10
805.	..	3	2 650.86	4r	4	4 327.07	6	3
930.	..	3	2 659.44 p	10r	10	4 442.55	10	5
935.	..	3	2 702.40	6r	6	4 498.75	10	10
1 056.	..	3	2 705.89	5r	5	4 520.90	10	4
1 118.	..	3	2 719.02	5r	4	4 552.41	10	10
1 199.	..	3	2 733.94	8r	6	4 657.95	6	3
1 213.	..	3	2 771.67	4r	2	4 684.09	5	1
1 226.	..	5	2 794.21	5r	6	5 059.48	10	3
1 287.	..	5	2 830.29 p	8r	5	5 227.64	10	2
1 461.	..	4	2 893.87	6	3	5 301.02	10	5
1 473.	..	4	2 929.79 p	8r	4	5 368.99	10	1
1 597.	..	3	2 997.96 p	7r	10	5 475.78	10	2
1 680.	..	5	3 042.62	4r	4	5 478.50	10	2
1 723.	..	4	3 064.71 P	6r	10	5 840.13	4	1
1 889.	..	5	3 139.37	8	3	6 326.6	10	1
1 928.5	..	5	3 156.56	8	3	6 523.5	4	....
2 288.19	6	3	3 200.72	7	3	6 710.39	10	....
2 310.97	3	5	3 204.05	9	4	6 842.60	8	....
2 357.10	4r	2	3 301.87	10	5	7 113.75	10	....
2 424.90	1	10	3 408.14	8	8	7 217.58	6	....
2 428.05	8r	2	3 485.27	8	3	8 224.79	6	....

Potassium

382.5	..	2	I 3 446.37	8r	3	I 5 112.5	3r	1
470.4	..	4	I 3 447.38	6r	2	I 5 323.4	4r	1
612.5	..	3	3 530.71	..	8	I 5 339.9	4r	2
765.7	..	3	3 608.88	..	5	I 5 343.2	4r	1
1 669.	..	$4_{(2)}$	3 618.43	..	5	I 5 359.7	5r	2
1 703.	..	9	3 681.5	..	4	I 5 782.6	5r	3
1 771.	..	6	3 897.9	..	8	I 5 801.9	6r	4
1 787.	..	4	4 001.2	..	5	I 5 812.4	6r	3
1 944.	..	5	I 4 044.16 p	10r	10r	I 5 832.0	7r	4
2 078.	..	10	I 4 047.22 p	10r	10r	I 6 911.3	10	4
2 190.	..	6	4 134.7	..	5	I 6 939.0	10	6
2 241.	..	5	4 149.2	..	5	I 7 664.94 P	10r	5r
2 358.	..	3	4 186.1	..	10	I 7 699.01 p	10r	5r
2 550.	..	5	4 223.0	..	5	7 931.	..	....
I 2 942.7	1r	....	4 225.6	..	4	I 8 500.	1	....
I 2 963.2	1r	....	4 263.3	..	8	I 8 908.	1	....
I 2 992.2	$1r_{(2)}$	3	4 309.0	..	5	I 9 590.	1	....
I 3 034.8	$4r_{(2)}$	....	4 388.13	..	5	I 11 028.0	10	....
3 062.4	..	5	4 466.66	..	4	I 11 689.76	10	....
I 3 102.0	4r	1	4 505.34	..	5	I 11 771.73	10	....
I 3 102.2	2r	....	4 608.43	..	6	I 12 434.3	10	....
I 3 217.2	6r	1	I 4 942.9	1r	1	I 12 523.0	9	....
I 3 217.6	4r	1	I 4 952.0	1r	....	I 15 165.8	10	....
3 345.7	..	5	I 4 956.6	1r	....	27 065.6	2	....
3 363.3	..	8	I 4 965.3	1r	....	I 27 215.0	1	....
3 364.7	..	6	5 005.58	..	5	I 31 395.	8	....
3 381.1	..	4	I 5 084.3	2r	1	I 31 596.8	4	....
3 385.3	..	4	I 5 097.6	2r	....	I 36 372.7	1	....
3 440.4	..	3	I 5 099.3	3r	1	I 36 626.4	3	....

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

Potassium (Continued)

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.
I 37 075.6	3	....	I 62 030.	2	....	I 74 260.	1	....
I 37 354.3	4	....	I 62 360.	2	....	I 84 520.	1	....
I 37 370.7	1	....	I 64 310.	1	....	I 85 100.	1	....
I 40 115.5	6	....	I 64 610.	1	....			

Praseodymium

2 488.75	..	5	4 189.52	10	10	5 381.27	4	2
2 980.51	..	8	4 206.72	10	10	5 469.88	5	....
2 985.77	..	8	4 223.00	10	10	5 509.16	4	2
3 355.66	3	1	4 225.34 p	10	10	5 605.63	5	2
3 645.66	3	1	4 241.03	10	10	5 668.46	6	....
3 687.05	4	3	4 272.27	9	5	5 707.60	6	....
3 739.19	4	3	4 280.09	8	4	5 815.24	8	1
3 762.35	4	1	4 297.75	8	5	5 823.70	6	1
3 800.31	5	4	4 305.80	10	10	5 879.18	6	1
3 816.10	9	8	4 333.98	10	8	5 939.94	5	2
3 877.22	10	10	4 368.33	9	8	6 017.82	5	2
3 908.05	7	4	4 405.84	8	5	6 055.13	6	....
3 908.43	10	8	4 408.83	10	10	6 161.20	5	2
3 918.85	7	5	4 429.23	10	10	6 281.34	5	....
3 947.63	9	4	4 449.84	8	4	6 359.07	5	....
3 964.82	9	4	4 468.67	9	8	6 429.7	5	1
3 972.15	8	3	4 496.43	10	10	6 431.9	5	....
3 982.06	9	6	4 510.15	10	10	6 478.1	5	....
3 989.70	10	5	4 517.58	6	2	6 566.8	5	....
3 994.81	10	5	4 534.15	6	4	6 656.9	6	....
4 008.73	10	8	4 563.13	5	3	6 673.68	10	....
4 054.87	9	6	4 628.74	4	3	6 747.17	6	....
4 056.54	9	8	4 736.72	4	2	6 798.69	8	....
4 062.83 p	10	8	4 783.39	4	1	6 827.70	6	....
4 100.75	10	10	5 110.40	6	2	7 021.55	6	....
4 118.49	10	10	5 110.79	6	3	7 114.58	4	....
4 141.26	10	6	5 173.92	6	4	7 451.72	4	....
4 143.14	10	10	5 220.11	5	3	7 645.68	3	....
4 164.19	10	10	5 322.77	5	3	7 721.82	3	....
4 179.43 p	10	10						

Radium

2 708.94	8	8	II 4 682.20 p	10	10	5 616.6	1	8
2 813.73	10	10	I 4 825.94 P	10	10	5 660.6	5	10
II 3 649.60	10	10	4 856.1	5	8	II 5 813.7	3	10
II 3 814.44 P	10	10	4 971.7	2	8	5 958.2	1	10
4 305.	3	7	5 400.1	2	8	6 167.2	1	8
II 4 340.67	10	10	5 406.6	2	8	6 200.4	5	10
II 4 436.22	5	10	5 501.8	1	8	6 337.0	1	6
II 4 533.17	10	10	5 601.5	..	8	6 446.1	5	8

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

Radon

Wave length.	Geissler tube.	Wave length.	Geissler tube.	Wave length.	Geissler tube.
3 612.	4	4 371.7	5	4 768.8	7?
3 665.	5	4 435.	5	4 797.	2
3 867.6	3	4 460.	7	4 817.5	7
3 957.3	5	4 508.	6	4 979.0	10
3 971.8	7	4 578.	8	5 084.5	10
3 981.8	9	4 604.6	9	5 393.	3
4 017.9	7	4 609.7	7	5 582.4	8
4 114.7	6	4 625.7	10	5 716.	6
4 166.5	10	4 644.4	10	5 945.	2
4 188.	4	4 681.0	10	5 977.	3
4 203.3	10	4 702.	5	6 309.	5
4 308.	10	4 721.7	5	7 057.	3
4 349.9	10				

Rhodium

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.
2 490.76	3	10	3 748.22	9	10	5 424.04	10	2
2 520.53	2	10	3 765.08	10r	10	5 535.02	10	1
2 625.40	2	8	3 793.22	10r	10	5 544.60	10	1
2 705.62	3	10	3 799.31	10r	10	5 599.43	10	3
2 715.30	2	10	3 822.35	10r	10	5 686.36	10	1
2 968.67	5	1	3 828.47	10r	10	5 806.86	10	1
3 263.14	9	2	3 833.87	10r	10	5 831.57	10	1
3 280.54	10r	5	3 856.50	10r	10	5 983.58	8	2
3 283.56	10r	5	3 934.23	10r	6	6 102.72	8	1
3 323.10 p	10r	10	3 958.86	10r	10	6 414.7	8	1
3 396.82 p	10r	10	4 082.80	10	5	6 519.72	10	....
3 434.90 P	10r	10	4 097.54	8	4	6 630.16	10	....
3 462.04	10r	8	4 128.90	10r	10	6 752.40	10	1
3 470.76	10r	8	4 135.29	10r	10	6 879.94	10	....
3 474.78	10r	7	4 211.14	10r	10	6 965.65	10	....
3 478.91	10r	10	4 288.72	10r	8	7 101.68	10	....
3 502.53	10r	10	4 374.82	10r	10	7 270.82	10	....
3 528.03	10r	10	4 379.93	8	3	7 475.74	10	....
3 583.10	10r	8	4 528.73	10	5	7 495.22	10	....
3 596.19	10r	10	4 675.02	10	5	7 791.61	9	....
3 597 15	10r	10	4 851.62	10	3	7 824.91	10	....
3 626 60	10r	10	5 193.12	10	3	7 830.05	6	....
3 657.99 p	10r	10	5 354.38	10	5	8 045.40	7	....
3 690.72	10r	10	5 379.08	10	3	8 136.20	4	....
3 692.35 p	10r	10	5 390.43	10	3	8 425.51	2	....
3 700.92	10r	10						

Rubidium

2 561.9	..	5	3 111.4	..	6	3 340.6	..	8
2 631.8	..	6	3 198.8	..	8	I 3 348.7	4r	4r
2 807.6	..	6	I 3 228.0	2r	2r	I 3 350.9	5r	5r
2 956.1	..	10	I 3 229.1	2r	2r	3 393.1	..	7
3 023.7	..	5	3 271.0	..	7	3 434.2	..	8
3 086.9	..	5	3 321.5	..	8	3 461.6	..	10

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

Rubidium (Continued)

	Wave length.	Arc.	Spark.		Wave length.	Arc.	Spark.		Wave length.	Arc.	Spark.
	3 492.7	..	10		4 377.1	..	10	I	7 280.2	10	....
	3 531.6	..	10		4 380.7	..	10	I	7 408.4	10	....
I	3 587.1	4r	4r		4 401.4	..	10	I	7 800.30 P	10r	....
I	3 591.6	4r	4r		4 426.1	..	10	I	7 947.63 p	8r	....
	3 600.7	..	10		4 430.7	..	10	I	10 082.	10	....
	3 662.7	..	10		4 530.3	..	6	I	13 237.	10	....
	3 699.6	..	10		4 571.8	..	10	I	13 444.	10	....
	3 801.9	..	10		4 622.4	..	10	I	13 667.	10	....
	3 940.6	..	10		4 648.6	..	10	I	14 754.	10	....
	3 978.1	..	10		4 776.0	..	9	I	15 290.	10	....
	4 083.9	..	10		4 782.9	..	7	I	38 511.	3	....
	4 104.3	..	10		4 885.6	..	5	I	39 827.	3	....
	4 136.2	..	10		5 152.1	..	6	I	39 898.	6	....
	4 193.0	..	10		5 522.8	..	6	I	46 190.	1	....
I	4 201.8 p	10r	9r		5 636.0	..	6	I	46 960.	8	....
I	4 215.6 p	10r	9r		5 699.2	..	6	I	52 313.	2	....
	4 244.4	..	10	I	5 724.5	4	2	I	64.360.	2	....
	4 273.1	..	10	I	6 206.5	8	2	I	65 670.	2	....
	4 293.9	..	10	I	6 298.6	10	3		72 690.	2	....
	4 348.3	..	10		6 775.1	..	9	I	74.280.	3	....
	4 371.8	..	10								

Ruthenium

	2 402.72	3	10	I	3 730.43	9r	8		5 401.00	10	1
	2 678.73 p	4	10	I	3 742.28	10r	3		5 427.61	10	1
	2 692.1 p	5	10	I	3 786.04	10r	10		5 454.82	10	1
	2 712.40 p	4	10	I	3 790.50	10r	10	I	5 484.33	10	1
	2 734.34	4	10	I	3 798.89	10r	10		5 510.72	10	1
	2 875.00	7	2	I	3 799.34	10r	10	I	5 636.24	8	3
	2 916.26	8	3		3 923.48	8	5	I	5 814.99	10	1
	2 945.67 p	3	10	I	4 080.62	10r	10	I	5 921.45	10	1
	2 965.55 p	3	10	I	4 112.76	9	5	I	6 444.81	9	....
	2 976.58 p	4	10	I	4 199.91	10r	10		6 690.0	10	....
	3 064.83	7	2	I	4 212.08	10	8		6 824.06	10	....
	3 177.03	3	8	I	4 297.72	10	10		6 923.22	10	....
I	3 294.13	8	8	I	4 372.21	10	10		6 981.99	10	....
	3 339.55	8	2	I	4 460.04	8	8	I	7 027.93	10	....
	3 417.35	10r	3	I	4 554.52	10r	10		7 238.95	9	....
	3 428.32	10r	3	I	4 584.45	10	8		7 393.92	8	....
I	3 436.74 p	10r	5	I	4 709.48	10	5		7 499.78	10	....
I	3 498.95 P	10r	8	I	4 757.85	10	3		7 621.52	6	....
I	3 593.03	10r	6	I	4 815.50	10	3		7 791.87	8	....
I	3 596.17 p	10r	6	I	4 869.16	10	3		7 809.18	9	....
	3 634.94	10r	3	I	5 136.55	10	1		7 881.48	10	....
I	3 661.35	8r	10	I	5 171.03	10	2		7 924.46	5	....
I	3 726.93	10r	8	I	5 309.26	10	2		8 264.95	4	....
I	3 728.02	10r	8		5 361.75	10	1		8 710.76	2	....

Samarium

	3 365.86	3	3		3 724.91	6	....		4 118.57	6	5
	3 408.66	3	3		3 739.16	6	5		4 203.03	6	6
	3 592.62	5	5		3 745.60	5	3		4 229.70	6	4
	3 634.27	4	4		3 986.66	4	2		4 256.40	5	5
	3 661.36	4	4		4 092.29	5	4		4 280.80	5	4

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

Samarium (Continued)

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.
4 318.95	5	8	5 493.72	6	....	6 601.84	5	....
4 390.86 p	5	10	5 498.22	6	....	6 679.25	5	....
4 424.35 P	6	10	5 519.64	5	....	6 731.86	6	....
4 434.34 p	6	8	5 550.38	6r	....	6 794.20	5	....
4 467.33	5	10	5 626.01	5	....	6 861.14	6	....
4 519.64	8	5	5 644.11	6	....	6 955.33	5	....
4 543.95	5	5	5 696.74	4	....	7 020.47	5	....
4 595.31	5	5	5 773.77	5	....	7 039.24	6	....
4 615.71	5	4	5 787.04	5	....	7 082.40	5	....
4 676.92	5	4	5 814.88	5	....	8 068.47	4	....
4 704.42	5	3	5 874.22	4	....	8 161.88	3	....
4 760.28	5	2	5 938.91	4	....	8 230.34	3	....
4 844.20	4	3	5 965.70	4	....	8 305.79	4	....
4 883.78	4	1	6 159.49	4	....	8 510.92	4	....
4 910.41	4	1	6 256.69	5	....	8 632.83	3	....
5 044.27	4	1	6 426.63	4	1	8 717.89	3	....
5 071.20	4	1	6 487.65	4	1	8 859.76	2	....
5 271.38	4	1	6 569.34	6	2	8 913.66	2	....
5 341.26	5	....						

Scandium

791.	..	5	II 3 572.55	10	10	5 031.03	10	4
1 214.	..	6	II 3 576.36	10	10	I 5 081.57	10	2
1 603.	..	5	II 3 580.96	10	10	5 239.82	10	2
1 880.	..	5	II 3 589.65	10	10	5 349.29	10	1
1 993.	..	5	II 3 590.50	10	10	5 481.98	10	1
2 062.	..	4	II 3 613.83 P	10	10	5 520.50	10	1
2 272.9	4	....	II 3 630.76 p	10	10	5 526.82	10	3
2 438.62	5	....	II 3 642.80 p	10	10	II 5 657.90	10	2
II 2 552.39	10	10	II 3 645.32	10	10	I 5 671.81	10	1
II 2 560.26	5	6	II 3 651.81	10	10	I 5 686.86	10	1
2 699.12	6	10	I 3 907.50 p	10	6	I 5 700.15	10	1
2 734.10	4	8	I 3 911.81 P	10	6	I 5 711.75	10	1
2 988.95	10	3	I 3 996.61	10	2	I 6 210.67	10	1
I 3 019.33	10	1	I 4 020.41	10	8	I 6 258.98	10	1
3 039.94	10	2	I 4 023.70	10	8	I 6 305.70	10	1
3 045.73	10	3	I 4 047.82	7	2	6 413.37	10	....
3 052.92	10	4	I 4 054.55	8	3	6 604.62	4	1
3 065.1	10	5	I 4 082.42	10	3	6 737.90	10	....
I 3 269.92	5	2	4 165.21	6	....	6 817.10	10	....
I 3 273.64	5	2	II 4 246.84	10	10	6 819.51	10	....
3 353.74	10	10	II 4 314.10	10	10	6 829.52	10	....
II 3 359.69	10	8	II 4 320.73	10	10	6 835.03	10	....
II 3 361.29	10	8	II 4 325.00	10	10	7 136.13	6	....
II 3 361.95	10	8	II 4 374.50	10	10	7 697.76	10	....
II 3 368.95	10	10	II 4 400.40	10	10	7 741.20	10	....
II 3 372.15	10	10	II 4 415.56	10	10	7 800.44	10	....
3 535.73	10	10	4 670.41	9	10	8 194.87	4	....
II 3 558.55	10	10	I 4 743.82	10	4	8 241.18	4	....
II 3 567.71	10	10						

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

Selenium

Wave length.	Geissler tube.	Spark.	Arc.	Wave length.	Geissler tube.	Spark.	Arc.
1 854.	.....	7	..	4 449.2	8	2	..
1 960. p	.....	10r	10	4 467.6	9	3	..
1 993.	.....	....	5	4 516.2	8	2	..
2 038.	.....	8	2	4 563.9	9	4	..
2 063. p	.....	8	8	4 604.3	9	5	..
2 073.	.....	3	8	4 618.7	8	3	..
2 354.3	5	3	..	4 648.4	8	5	..
2 459.5	7	3	..	I 4 730.9 P	10	....	..
2 591.4	10	5	..	I 4 739.1 p	9	....	..
2 630.9	8	5	..	I 4 742.4 p	8	....	..
2 685.9	8	4	..	4 763.6	8	2	..
2 767.4	10	3	..	4 840.5	8	1	..
2 777.7	9	3	..	4 844.8	10	1	..
2 837.2	8	4	..	4 975.7	8	....	..
2 880.4	8	3	..	4 992.9	8	1	..
2 914.9	9	3	..	5 031.3	8	....	..
2 951.7	10	3	..	5 068.6	8	1	..
3 038.7	8	2	..	5 096.5	8	1	..
3 060.8	10	....	..	5 142.1	8	1	..
3 069.9	8	2	..	5 176.0	9	2	..
3 094.3	8	3	..	5 227.5	9	2	..
3 185.5	9	3	..	5 253.7	7	....	..
3 225.9	8	3	..	5 271.1	8	....	..
3 323.1	8	3	..	5 305.3	9	....	..
3 379.8	8	3	..	I 5 365.4	8	....	..
3 387.2	10	6	..	I 5 369.9	10	....	..
3 514.	10	8	..	I 5 374.1	10	....	..
3 544.	10	10	..	5 455.8	7	....	..
3 637.5	10	10	..	5 522.6	8	....	..
3 711.6	10	6	..	5 567.0	9	....	..
3 738.7	10	10	..	5 591.2	8	....	..
3 800.9	10	8	..	I 5 617.8	5	....	..
3 849.6	8	2	..	5 623.1	9	....	..
3 877.3	8	4	..	5 697.9	8	....	..
3 901.6	8	....	..	I 5 718.1	7	....	..
4 008.1	8	2	..	5 747.6	7	....	..
4 046.7	10	3	..	I 5 753.3	7	....	..
4 083.2	8	3	..	5 842.6	6	....	..
4 108.8	8	3	..	5 866.2	6	....	..
4 169.0	10	3	..	I 5 961.9	5	....	..
4 176.	9	10	..	I 6 325.6	6	....	..
4 182.	9	10	..	I 6 679.5	5	....	..
4 280.3	8	2	..	I 6 699.6	6	....	..
4 320.4	9	3	..	I 6 746.4	6	....	..
4 382.8	10	6	..	I 6 831.0	5	....	..
4 401.0	9	3	..	I 7 061.9	5	....	..
4 446.0	8	....	..				

Silicon

Wave length.	Arc.	Spark.	Geissler tube.	Wave length.	Arc.	Spark.	Geissler tube.
IV 361.6	..	....	1	IV 749.7	..	....	3
IV 457.7	..	....	3	IV 815.0	..	....	7

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

Silicon (Continued)

Wave length.	Arc.	Spark.	Geissler tube.	Wave length.	Arc.	Spark.	Geissler tube.
IV 818.0	..	....	7	III 2 541.83	..	10	.....
IV 1 066.3	..	....	8	I 2 631.28	5	6	.....
III 1 110.47	..	....	5	I 2 881.59 P	10r	10	.....
II 1 194.89	..	....	5	I 2 987.65	5	4	.....
III 1 206.9	..	....	10	III 3 086.23	..	....	7
II 1 260.66	..	....	8	III 3 093.42	..	....	6
II 1 265.04	..	....	10	IV 3 149.56	..	....	6
IV 1 393.9	..	....	10	IV 3 165.72	..	....	8
IV 1 402.9	..	....	8	III 3 590.46	..	2	8
III 1 500.39	..	....	5	III 3 791.41	..	6	3
II 1 526.38 p	..	....	8	III 3 796.11	..	7	4
II 1 533.55 P	..	....	10	III 3 806.56	..	3	5
II 1 711.0	..	....	6	II 3 853.66	..	3	3
II 1 808.14	..	....	8	II 3 856.02	..	5	8
II 1 817.06	..	....	10	II 3 862.59	..	4	6
1 885.	..	10	.....	I 3 905.52 p	10	5	10
I 1 988.97	..	5	.....	IV 4 088.86	..	6	10
I 2 058.20	..	....	5r	II 4 128.05	..	5	8
II 2 071.94	..	....	8	II 4 130.88	..	6	10
II 2 072.61	..	....	10	III 4 552.65	..	3	9
I 2 124.12	..	6r	.....	III 4 567.87	..	2	7
I 2 216.69	3	3	.....	III 4 574.78	..	1	4
IV 2 287.08	..	10	.....	II 5 041.06	..	1	8
I 2 435.16	5r	5	.....	II 5 056.02	..	2	10
I 2 506.90 p	10r	6	.....	I 5 708.40	..	....	5
I 2 514.32	8r	5	.....	III 5 739.76	..	....	8
I 2 516.12 p	10r	10	.....	II 5 957.61	..	....	5
I 2 519.21	8r	5	.....	II 5 978.97	..	....	7
I 2 524.12	10r	8	.....	II 6 347.09	..	5	10
I 2 528.52 p	10r	8	.....	II 6 371.36	..	2	8

Silver

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.
1 445.	..	5	1 916.3	..	4	2 205.9	1	2
1 486.	..	4	1 932.3	..	2	2 208.4	1	1
1 496.	..	4	1 956.9	..	3	2 211.18	..	2
1 539.	..	4	1 999.5	..	2	2 219.70	..	2
1 566.	..	6	2 000.6	..	3	2 226.12	..	2
1 656.8	..	5	2 033.8	..	4	2 229.51	2	4
1 674.	..	2	2 061.	..	1	2 238.36	..	2
1 693.	..	6	2 065.9	..	4	2 240.42	..	2
1 722.	..	3	2 070.0	..	1	2 246.38 p	3	3
1 751.	..	6	2 113.8	2	3	2 248.73	3	3
1 769.	..	4	2 120.4	1	2	2 253.46	..	2
1 772	..	4	2 125.4	..	1	2 275.24	..	2
1 794.	..	4	2 145.6	1	3	2 277.38	..	2
1 802.	..	4	2 162.0	..	2	2 279.97	1	5
1 816.	..	3	2 166.5	2	2	2 309.54	6r	4
1 839.	..	3	2 170.9	..	1	2 312.4	4N	2
1 860.	..	4	2 171.7	..	1	2 317.03	2	5
1 873.	..	4	2 186.76	2	3	2 320.24	2	6
1 880.	..	4	2 192.	1	1	2 321.52	..	3
1 889.	..	4	2 202.1	2	2	2 324.63	2	6

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

Silver (Continued)

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.
2 325.1	..	4	2 824.40	6	1	3 616.	..	1
2 331.35	4	6	2 873.59	2	4	3 624.2	1n	....
2 357.92	..	6	2 896.46	..	4	I 3 682.3	2n	1
2 358.85	..	5	I 2 902.08	..	4	3 710.	1	....
2 362.19	..	3	2 920.0	..	3	3 810.7	2n	1
2 363.99	..	4	2 929.3	..	5	I 3 840.79	2	1
2 375.0	4N	3	2 934.2	..	6	3 949.4	1	2
2 383.20	..	2	2 938.5	4	4	I 3 981.63	4<	1
2 386.32	..	3	2 983.52	..	1	3 985.	..	2
2 386.8	..	2	3 012.9	..	1	I 4 055.25	8r	3
2 390.57	..	3	3 099.11	2	1	4 085.9	..	3
2 392.97	..	2	3 115.	..	1	I 4 212.01	8r	4r
2 395.66	..	2	3 117.8	..	1	4 311.05	2<	2
2 402.57	..	3	3 130.0	3	1	4 379.24	2n	....
2 411.38	..	7	3 153.1	..	2	4 385.	..	1
2 413.22	4	8	3 170.6	2	1	4 396.	2n	1
2 420.12	..	5	3 172.3	..	1	4 447.0	..	1
2 429.65	..	7	3 173.6	..	1	I 4 476.06	6	4
2 437.77 p	3	8	3 180.7	..	2	4 556.	3N	1
2 444.20	..	4	3 185.1	..	1	4 615.9	3N	1
2 447.91	2	7	3 187.8	..	1	I 4 668.54	8<	3
2 453.37	..	6	3 191.8	..	1	4 677.9	2n	1
2 460.32	..	5	3 200.0	..	1	4 848.1	2N	....
2 462.27	..	4	3 207.3	..	1	4 874.16	2<	1
2 472.94	..	2	3 215.6	2	1	4 888.3	2n	....
2 473.88	..	7	3 216.7	..	1	I 5 209.04	10r	8
2 477.30	..	6	3 223.	..	2	5 276.4	1<	....
2 480.42	..	4	3 233.	3n	1	5 329.7	4<	....
2 485.78	..	2	3 241.3	..	1	5 333.3	2<	....
2 486.7	..	2	3 244.97	..	3	5 401.	..	1N
2 504.07	..	4	3 249.8	..	1	5 403.	..	1N
2 506.65	2	5	3 252.8	..	1	I 5 465.43	10	6
2 535.3	..	5	3 267.33	..	1	I 5 471.51	6	5
2 553.41	..	2	3 280.67 P	10r	9r	5 489.	..	3N
2 564.42	..	3	3 289.2	..	2	5 494.	..	1N
2 567.15	..	2	3 299.4	..	2	5 523.7	3	....
2 575.5	4N	1n	3 301.5	..	2	5 529.9	2	....
2 580.7	..	6	3 305.7	2	....	5 545.65	4<	....
2 595.6	..	3	3 312.6	..	1	5 558.	..	1N
2 606.14	..	6	3 331.8	..	2	5 570.	..	1N
2 614.5	..	6	3 349.	1	....	5 590.	..	1n
2 628.6	..	2	3 352.	..	1	5 666.4	4n	2n
2 656.8	..	6	3 364.	..	1	5 970.	..	1
2 660.4	3	5	I 3 382.88 p	10r	9r	6 037.	..	2
2 681.4	..	4	3 409.	1	....	I 7 687.85	10	....
2 688.4	..	3	3 413.	1	....	I 8 273.58	10	....
2 712.1	..	4	3 456.	1	....	I 12 551.	1	....
2 721.79	3	2	3 469.2	1	1	I 16 819.	3	....
2 743.9	..	3	3 475.8	..	2	I 17 415.	1	....
2 756.4	..	6	3 501.8	3	1	I 18 307.	1	....
2 767.5	..	8	3 505.1	..	1	I 18 382.	1	....
2 786.5	..	3	3 507.	1	....	39 889.	5	....
2 799.64	..	6	3 520.	1	....	39 951.	8	....
2 815.6	..	4	3 542.5	3	2			

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

Sodium

	Wave length.	Arc.	Spark.		Wave length.	Arc.	Spark.		Wave length.	Arc.	Spark
	1 372.3	..	2		2 847.	..	4	I	4 748.1	3n	2
	1 376.6?	..	1	I	2 852.8	4r	5	I	4 752.0	4n	2<
	1 659 7	..	4	I	2 853.0	5r	5	I	4 979.0	5<	4
	1 668.7	..	4		2 951.4	..	5	I	4 983.2	6<	4<
	1 669.3	..	4		2 980.	..	4	I	5 675.8	..	8
	1 698.9?	..	10		2 984.3	..	4	I	5 682.8	8	8<
	1 703.5	..	9		3 056.3	..	3	I	5 688.3	10	8<
	1 749.3	..	8		3 078.5	..	4	I	5 889.97 P	10r	10
	1 770.8	..	6		3 093.	..	6	I	5 895.93 p	8r	10
	1 773.5	..	6		3 129.	..	6	I	6 154.4	4	3
	1 787.4	..	4		3 189.	..	4	I	6 160.8	5	4
	2 490.7	1r	....		3 285.	..	5	I	8 183.33	8	....
	2 493.3	..	2	I	3 302.34 p	9r	9r	I	8 194.93	10	....
I	2 512.1	1r	1	I	3 302.94 p	8r	8r	I	11 382.4	10	....
I	2 512.2	1r			3 533.1	..	8	I	11 404.2	10	....
I	2 543.8	2r	1		3 631.	..	5	I	18 459.5	10	....
I	2 543.9	1r			3 711.	..	3	I	40 449.	8r	....
I	2 593.8	3r	3	I	4 393.	3	1	I	74 430.	1r	....
I	2 593.9	2r		I	4 665.	3<	3n	I	90 480.	..	3
I	2 680.3	4r	4	I	4 669.	4<	3n	I	90 850.	..	4
I	2 680.4	3r									

Strontium

II	1 613.	4	....	I	4 876.07	6	1	I	6 791.07	6	1
II	1 620.	5	....	I	4 876.31	6	1	I	6 878.37	10	....
II	1 769.	8	....	I	4 892.01	6	2	I	7 070.15	10r	1
II	1 778.	9	....	I	4 962.25 p	6r	2	I	7 167.30	6	....
II	2 166.	1r	1	I	4 967.92	4	1	I	7 232.24	5	....
I	2 354.3	1r	....	I	5 156.08	5	1	I	7 309.45	7	....
I	2 428.11	3r	....		5 222.21	5	1	I	7 621.53	5	....
I	2 569 50	3r	....		5 225.12	5	1		7 673.10	6	....
I	3 301.74	5	2		5 229.28	5	1	II	10 038.	10	....
I	3 307.54	4	1		5 238.56	6	1	II	10 328.	10	....
I	3 322.23	5	1		5 256.91	6	3	II	10 915.	10	....
	3 330.01	4	2	I	5 480.87	7	4	I	11 242.	10	....
I	3 351.26	6r	2	I	5 486.13	5	2		17 137.	..	....
II	3 366.33	5	2	I	5 504.19	5	3		17 170.	..	....
II	3 380.72	5	6	I	5 521.76	6	3		17 446.	..	....
I	3 464.47	6	7	I	5 534.80	5	2	I	20 262.	10	....
I	3 940.80	5	2	I	5 540.04	5	2		20 705.	..	....
II	4 030.38	5	4	I	5 543.32	5	2		20 767.	..	....
II	4 077.71 P	10r	10r		5 598.4	6	1	I	26 024.	6	....
II	4 161.81	4	3	I	6 363.95	4	1		26 714.	..	....
II	4 215.52 p	9r	9r	I	6 369.98	4	1		26 806.	..	....
I	4 305.47	4	4	I	6 380.74	5	1	I	26 915.	6	....
I	4 361.71	4	2	I	6 386.53	7	1		26 947.	..	....
I	4 438.04	6	3	I	6 388.27	6	1	I	27 356.	6	....
I	4 607.34 P	10r	6r		6 408.48	9	4		28 516.	..	....
I	4 722.27	6	3		6 504.01	8	4		28 964.	..	....
I	4 741.91	5	1		6 546.80	5	2	I	29 225.	6	....
I	4 811.86	6r	4		6 550.27	6	3	I	30 110.	5	....
I	4 832.07 p	6	3		6 617.27	6	3		30 482.	..	....
I	4 855.07	4	1		6 643.55	5	2	I	30 665.	..	....
I	4 872.48 p	6	2								

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

Sulfur

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.
IV 661.42	6	....	4 332.7	1	5	5 614.3	..	5
IV 753.75	6	....	4 362.5	..	6	5 640.0	..	8
IV 750.23	5	....	4 525.0	..	6	5 647.1	..	8
IV 748.40	5	....	4 694.2 p	..	10	5 660.1	..	6
IV 744.92	5	....	4 695.5 p	..	8	I 5 696.8	..	6
V 786.51	6	....	4 696.3 p	..	6	I 5 700.4	..	7
IV 815.97	5	....	4 925.3	..	6	1 5 706.2	..	8
V 854.81	5	....	5 009.6	..	6	I 6 042.0	..	5
VI 933.42	5	....	5 014.0	..	8	I 6 046.0	..	6
IV 3 098.36	5	....	5 032.5	..	8	I 6 052.8	..	7
3 497.3	8	....	5 201.0	..	6	I 6 403.5	..	2
3 717.7	5	6	5 212.6	1	8	I 6 408.1	..	3
3 837.37	4	7	5 278.1	..	3	I 6 415.5	..	4
3 838.29	8	8	5 278.6	..	5	6 538.1	..	6
3 928.5	..	8	5 279.0	..	6	I 6 743.7	..	5
3 983.7	..	5	5 320.7	..	8	I 6 748.8	..	6
3 993.5	..	5	5 345.7	..	8	I 6 757.2	..	7
4 028.8	..	6	5 428.7	..	9	7 244.8	..	6
4 142.5	2	8	5 432.8	..	10	7 679.6	..	4
4 145.1	2	10	5 453.8	..	10	7 686.1	..	6
4 253.2	..	8	5 473.6	..	8	7 696.7	..	8
4 163.	3	10	I 5 507.0	..	5	8 585.6	..	6
4 174.31	1	7	5 509.6	..	10	8 694.3	..	4
4 189.9	..	5	5 564.9	..	8	I 9 212.80 p	..	2
4 253.60	..	10	5 579.1	..	6	I 9 228.17 p	..	2
4 284.97	5	8	5 606.1	..	8	I 9 237.71 p	..	3
4 294.42	..	8n						

Tantalum

2 647.46	3	2	3 566.72	4	1	5 461.29	4	2
2 714.67	3	2	3 607.40	7	2	5 518.89	3	2
2 758.31	3	1	3 626.61	9	3	5 664.88	6	3
2 802.07	3	1	3 642.05	10	2	5 776.71	7	2
2 891.85	4	1	3 918.51	3	2	5 811.09	8	....
2 933.56	5	2	4 026.95	4	2	5 882.29	5	....
2 965.15	4	4	4 067.91	6	2	5 997.24	7	....
3 012.53	5	3	4 129.42	5	2	6 045.4	5	....
3 049.54	5	1	4 175.22	4	3	6 256.62	8	2
3 103.25	5	1	4 205.88	6	2	6 268.66	8	2
3 124.96	4	1	4 279.06	3	2	6 309.56	8	3
3 170.28	4	1	4 415.73	3	3	6 389.42	8	3
3 223.83	4	2	4 510.98	8	3	6 430.76	9	5
3 242.05	4	....	4 530.82	5	3	6 450.36	10	5
3 311.14 P	9	3	4 574.32	5	3	6 485.36	10	10
3 317.91	7	1	4 681.87	5	5	6 514.36	9	3
3 361.63	5	1	4 691.89	3	2	6 516.11	10	3
3 406.94 p	5	2	4 740.14	4	2	6 673.70	4	1
3 436.00	5	1	4 812.74	4	2	6 675.51	5	2
3 497.85	5	....	4 936.40	3	1	6 866.20	3	1
3 511.03	8	2	5 136.47	3	3	6 966.16	2	....

Tellurium

509.	..	1	813.	..	5	931.	..	4
634.	..	1	928.	..	4	1 004.	..	5

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

Tellurium (Continued)

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.
1 007.	..	5	1 297.	..	5	2 383.27 p	10r	10r
1 064.	..	5	1 345.	..	7	2 385.78 p	10r	10r
1 107.	..	5	1 461.	..	7	2 530.73 p	7	5
1 117.	..	5	1 826.	..	5	2 769.65 p	9	4
1 123.	..	7	2 081.8	8	....	3 175.13	9	2
1 150.	..	5	2 143.0 p	9r	1	4 866.5	..	4
1 167.	..	10	2 147.33	8	1	5 045.2	..	4
1 174.	..	7	2 160.12	6	1	5 449.7	..	5
1 216.	..	7	2 208.88	6	2	5 649.3	..	10
1 219.	..	7	2 255.50	5r	3	5 708.1	..	10
1 223.	..	7	2 259.02	8r	3	5 755.8	..	8
1 291.	..	5	2 265.52	5r	3	6 438.0	..	10

Terbium

2 539.91	..	8	3 981.90	10	10	4 752.50	10	8
2 658.91	..	10	4 005.57	8	10	4 813.77	6	....
2 891.29	..	10	4 012.85	7	5	4 837.58	6	1
2 909.24	..	10	4 033.07	8	8	4 875.58	6	1
2 913.28	..	10	4 061.59	6	2	4 881.14	6	2
3 078.87	4	8	4 066.22	5	3	4 915.91	6	....
3 139.65	4	3	4 094.44	5	4	4 931.79	6	....
3 218.95	5	5	4 144.46	5	10	4 970.99	5	....
3 274.24	6	....	4 187.16	5	....	4 993.85	6	....
3 293.08	5	8	4 278.54	10	10	5 065.79	5	....
3 324.40	8	5	4 313.25	6	1	5 089.11	5	1
3 413.77	5	4	4 318.85	6	3	5 228.11	5	....
3 454.06	7	4	4 342.53	6	2	5 319.23	5	....
3 509.18 p	10	10	4 353.20	6	3	5 354.87	5	....
3 561.75 p	10	10	4 356.84	6	2	5 369.71	5	....
3 568.52	7	5	4 367.31	5	3	5 375.98	5	....
3 628.20	8	3	4 423.11	5	1	5 424.10	5	....
3 638.45	7	5	4 436.13	5	....	5 470.34	5	....
3 650.42	7	8	4 493.08	5	2	5 524.11	5	....
3 658.87	8	8	4 511.52	6	....	5 685.72	5	....
3 676.35	8	10	4 563.69	6	1	5 747.58	6	....
3 702.85	6	10	4 578.68	8	3	5 785.18	5	....
3 703.93	8	8	4 641.98	8	3	5 803.11	5	....
3 711.75	10	4	4 645.29	9	2	5 851.07	5	....
3 765.14	6	8	4 662.79	6	1	5 967.35	5	....
3 776.50	8	8	4 681.86	8	....	6 038.97	4	....
3 848.76 p	10	10	4 702.40	8	2	6 331.68	4	....
3 874.19 p	10	10	4 716.08	6	....	6 677.94	6	....
3 899.19	8	8	4 734.19	6	1	6 785.12	4	....
3 925.45	10	10	4 739.92	6	1	6 794.58	5	....
3 939.54	10	10	4 747.79	6	....	6 896.37	5	....
3 976.86	10	10						

Thallium

395.	..	1	1 082.	..	4	1 561.	..	8
662.	..	3	III 1 266.	..	8	1 660.	..	10
697.	..	4	1 337.	..	4	1 793.	..	9
817.	..	3	1 478.	..	4	1 815.	..	10
908.	..	2	1 492.	..	4	1 828.	..	6
1 029.	..	4	III 1 559.	..	10	1 893.	..	10

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

Thallium (Continued)

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.
I 2 207.1	4r	2	4 738.1	..	10	I 14 515.	10	....
I 2 237.8	6r	3r	5 153.3	..	10	I 14 593.	1	....
I 2 316.0	6r	4	I 5 350.47 P	10r	10	I 14 598.	3	....
I 2 379.60	8r	10r	5 948.9	8	8	I 16 123.	10	....
I 2 517.44	4r	....	I 6 550.	8	3	I 16 340.	10	....
I 2 552.5	6r	....	6 714.	5	2	20 486.	1	....
I 2 552.9	2r	....	I 8 376.	1	....	21 397.	1	....
I 2 580.16	8r	6r	I 9 136.	2	....	I 21 803.	3	....
I 2 585.6	4r	1	I 9 171.	2	....	27 024.	1	....
I 2 608.98	6r	2	I 9 513.	3	....	I 27 889.	4	....
I 2 609.75	4r	....	I 10 292.	6	....	I 33 393.	1	....
I 2 709.24	8r	6r	I 10 492.	5	....	I 35 680.	1	....
I 2 710.7	4r	4	I 10 496.	8	....	I 35 950.	2	....
I 2 767.89	10r	10	I 11 482.	5	....	I 38 131.	5	....
I 2 826.2	8r	....	I 11 513.	10	....	I 39 215.	2	....
I 2 918.34	10r	1	I 11 594.	8	....	I 39 246.	2	....
I 2 921.53	6r	1	11 691.	1	....	39 286.	6	....
I 3 229.76	10r	1	I 12 492.	2	....	I 51 058.	2	....
I 3 519.22	10r	10r	12 728.	2	....	I 55 590.	1	....
I 3 529.41	8r	10	I 12 736.	10	....	I 70 230.	1	....
I 3 775.73 p	10r	10r	I 13 014.	10	....	I 71 170.	1	....

Thorium

2 413.50	..	6	4 069.23	3	7	5 539.89	5	2
2 427.98	..	8	4 085.05	3	7	5 604.48	4	1
2 431.74	..	7	4 116.75	2	6	5 639.71	5	1
2 441.30	..	9	4 178.04	3	5	5 707.07	4	1
2 463.72	..	7	4 208.85	4	8	5 749.32	4	1
2 512.72	..	8	4 381.89	5	10	5 815.38	4	....
2 686.17	..	6	4 391.12	5	10	5 870.51	4	1
2 898.92	..	6	4 510.54	4	5	5 914.38	4	1
2 978.68	..	8	4 602.88	5	1	5 989.02	7	2
3 097.92	..	6	4 619.50	7	3	6 015.41	4	1
3 108.26	4	5	4 740.47	6	4	6 087.28	5	1
3 188.22	5	5	4 752.41	6	4	6 099.08	4	1
3 216.58	..	8	4 761.10	5	3	6 104.79	4	1
3 221.27	2	10	4 774.27	5	2	6 112.84	4	1
3 232.08	1	7	4 818.62	4	4	6 120.56	4	1
3 290.59 p	..	10	4 832.78	5	2	6 261.06	4	1
3 300.54	1	10	4 863.17	9	8	6 274.14	4	1
3 313.69	1	10	4 919.80	9	6	6 342.86	4	....
3 392.05	4	5	4 964.15	5	1	6 358.64	4	....
3 469.94	4	5	4 987.16	5	3	6 376.94	4	....
3 507.57	..	10	5 017.24	8	3	6 396.4	4	....
3 511.64	5	6	5 028.59	5	2	6 411.91	4	....
3 538.75 p	1	10	5 049.77	7	3	6 416.10	4	....
3 601.05 p	3	7	5 067.97	5	....	6 457.26	4	....
3 617.07	4	5	5 148.17	4	2	6 462.64	5	1
3 627.40	..	2r	5 247.65	5	2	6 531.3	4	....
3 659.51	3	6	5 277.45	5	2	6 584.0	4	....
3 741.21	5	6	5 325.10	4	2	6 989.7	4	....
3 752.58	4	6	5 435.86	4	1	6 993.1	4	....
4 019.14 p	5	10	5 462.58	4	1	7 054.8	4	....

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

Tin

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.
392.	..	1	2 113.9	4r	1r	3 283.5	..	10
410.	..	2	2 121.2	3r	....	3 330.60	6r	6
502.	..	2	2 140.6	3r	1	3 352.3	..	10
508.	..	2	2 148.6	3r	1	3 801.03	9r	8r
752.	..	3	2 151.4	3r	2	4 524.74 p	6	10
784.	..	3	2 171.3	3r	....	4 585.6	..	10
892.	..	3	2 194.5	3r	2r	5 333.	..	10
902.	..	15	2 199.3	3r	2r	5 562.7	..	10
907.	..	3	2 209.63	3r	2r	5 589.4	..	10
910.	..	3	2 231.73	4r	2	5 731.70	7	3
956.	..	10	2 246.05	3r	3r	5 799.4	..	10
1 019.	..	15	2 268.92	3r	3r	5 970.3	5	....
1 044.	..	15	2 286.68	4r	3r	6 037.7	5	....
1 058.	..	3	2 317.22	5r	4r	6 054.9	5	....
1 062.	..	3	2 334.80	4r	4r	6 069.0	7	....
1 086.	..	5	2 354.84	5r	6r	6 149.6	6	....
1 089.	..	5	2 408.18	4r	3	6 154.6	5	....
1 132.	..	12	2 421.70	6r	8r	6 171.5	4	....
1 158.	..	20	2 429.51	7r	8r	6 310.8	4	....
1 224.	..	10	2 483.40	5r	4r	6 453.5	3	6
1 251.	..	20	2 495.72	5r	4r	6 579.2	..	4
1 314.7	..	10	2 546.56	5r	5r	6 844.2	2	2
1 327.	..	7	2 571.60	5r	5r	8 114.1	7	....
1 347.	..	4	2 594.43	4r	3r	8 552.6	7	....
1 370.	..	4	2 658.61	..	10	9 852.	1	....
1 387.	..	5	2 661.25	5r	4r	10 458.	1	....
1 410.8	..	5	2 706.50	7r	7r	10 808.	1	....
1 437.7	..	10	2 779.81	4r	5	10 896.	4	....
1 475.	..	6	2 785.02	3r	4	11 194.	7	....
1 570.	..	4	2 813.58	5r	4r	11 279.	10	....
1 757.	..	10	2 839.99 p	8r	10r	11 457.	6	....
1 811.	..	10	2 850.61	6r	7r	11 618.	6	....
1 899.	3	10	2 863.32 p	8r	8r	11 672.	2	....
1 951.4	3r	....	2 913.54	6r	4	11 740.	9	....
1 983.4	3r	....	3 009.14 p	9r	8r	11 827.	4	....
2 040.	4r	....	3 032.78	3r	3	11 853.	4	....
2 072.9	5r	....	3 034.12 p	9r	8r	11 934.	10	....
2 091.6	3r	1	3 175.05 p	10r	9r	12 983.	5	....
2 096.3	4r	....	3 262.33 p	10r	5r	13 022.	2	....
2 100.8	4r	....						

Titanium

324.	..	1	III 2 375.0	..	6	I 2 646.64	9	2
781.6	..	10	I 2 384.53	3	1	I 2 661.97	5	....
834.0?	..	2	2 414.0	..	10	I 2 669.60	6	2
1 113.4	..	5	I 2 418.36	3	1	I,II 2 742.33	7	4
1 120.5	..	5	III 2 516.0	..	10	II 2 751.7	..	8
1 264.6	..	5	II 2 525.62	4	10	I 2 758.07	6	1
III 1 294.3	..	2	III 2 527.8	..	10	II 2 805.0	..	10
III 1 298.8	..	2	III 2 540.0	..	10	II 2 810.30	4	10
1 437.3	..	5	III 2 563.4	..	10	II 2 817.84	..	10
1 658.7	..	10	I 2 599.91	6	2	II 2 828.07	3	8
1 671.2	..	10	I 2 611.28	7r	1	II 2 841.94	8	4
IV 2 068.3	..	2	I 2 619.94	5	1	II 2 884.10	7	8
2 074.6	..	2	I 2 641.09	9	2	I 2 912.09	8	2
III 2 346.8	..	6	I 2 644.26	9	3	I,II 2 941.99	9	4

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

Titanium (Continued)

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.
I 2 948.25	9	2	I 3 729.81	8r	4	I 4 623.11	9	3
I 2 956.13	10	2	I 3 741.07	10	2	I 4 656.46	8	3
I 2 967.22	8	2	I 3 741.65	3	10	I 4 667.59	10	5
III 2 984.8	...	10	I 3 752.87	10	5	I 4 681.91	9	6
II 3 072.11	8	3	II 3 759.30	9	10	I 4 691.34	8	4
II 3 072.97	8	3	II 3 761.33	8	10	I 4 698.77	8	3
II 3 075.23	9	4	I 3 882.88	9	3	I 4 731.17	5r	3
II 3 078.65	9	6	II 3 900.54	5	10	I 4 758.13	8	5
II 3 088.03	10	10r	II 3 913.47	5	10	I 4 759.28	8	6
II 3 162.57	9	6	I 3 947.77	8	3	I 4 820.42	7	3
II 3 168.52	9	10	I 3 948.70	10	4	I 4 840.88	9	4
I 3 186.46	9r	3	I 3 956.34	10	4	I 4 870.14	7	3
II 3 190.88	7	10	I 3 958.21	10	5	I 4 885.09	8	5
I 3 192.00	9r	1	I 3 962.86	7	3	I 4 981.73 p	9	10
I 3 199.92	9r	3	I 3 964.27	7	3	I 4 991.07 p	9	10
II 3 202.54	6	10	I 3 989.76	10	6	I 4 999.51 p	10	10
II 3 217.06	8	8	I 3 998.64	10	6	I 5 007.21 p	9	10
II 3 222.84	7	8	I 4 009.66	7	4	I 5 014.25	10	9
II 3 224.24	5	8	I 4 024.58	7	3	I 5 020.03	8	5
II 3 234.52	8r	10r	I 4 078.48	6	4	I 5 022.87	9	5
II 3 236.58	7r	6r	II 4 163.66	4	10	I 5 024.85	9	3
II 3 239.04	7r	6r	II 4 171.92	3	10	I 5 025.58	8	3
II 3 241.99	7	10	I 4 274.59	10	4	I 5 035.91	7	9
II 3 248.60	4	10	I 4 282.71	6	3	I 5 036.47	9	8
II 3 261.60	4	10	I 4 287.42	9	4	I 5 038.41	9	8
II 3 322.94	8r	10	I 4 289.08	10	4	I 5 039.96	9	3
II 3 329.46	6r	10	II 4 290.23	4	10	I 5 064.66	10	5
II 3 332.11	5	8	I 4 290.94	8	2	I 5 173.74	7r	7
II 3 335.19	7	10	II 4 294.11	6	10	II 5 188.69	4	10
I 3 341.87	6r	10r	I 4 298.68	10	4	I 5 192.97	8r	10
II 3 349.04 P	6r	8r	II 4 300.06	6	8	I 5 210.39	8r	9
II 3 349.41	9r	10r	I 4 300.56	10	2	II 5 226.55	3	10
I 3 354.64	8	3	I 4 301.08	10	3	I 5 283.45	7	3
II 3 361.22 p	8r	10r	I 4 305.92	10	8	I 5 297.25	7	3
I 3 370.44	9r	2	II 4 307.89	..	8	II 5 336.80	3	10
I 3 371.46	9r	2	I 4 314.81	7	3	I 5 477.73	9	4
II 3 372.80 p	10	10r	II 4 337.92	5	10	I 5 488.23	6	3
II 3 380.29	7	10	II 4 395.04	7	10	I 5 512.53	8	10
II 3 383.77 p	8r	10	I 4 427.11	8	4	I 5 514.35	7	8
I 3 385.95	8r	....	I 4 443.81	6	10	I 5 514.54	8	8
II 3 387.84	8	10	II 4 455.33	10	4	I 5 565.47	7	8
II 3 394.58	2	10	I 4 457.44	9	5	I 5 644.14	7	10
II 3 444.32	4	10	I 4 468.50	6	10	I 5 662.16	7	8
II 3 452.48	1	8	II 4 501.28	5	10	I 5 662.92	7	3
II 3 456.39	2	9	I 4 512.74	10	4	I 5 675.43	7	4
II 3 461.50	9	10	I 4 518.03	9	4	I 5 689.48	8	3
II 3 477.19	9	10	I 4 522.81	9	4	I 5 702.68	6	2
II 3 504.89	7	10	I 4 527.32	10	4	I 5 708.23	5	1
II 3 510.85	8	10	I 4 533.25	10r	5	I 5 715.12	8	2
II 3 520.26	3	8	I 4 534.78	9r	4	I 5 762.28	7	2
II 3 535.41	4	10	I 4 535.58	8r	3	I 5 766.33	7	3
I 3 635.47 p	9r	3	I 4 535.92	6r	....	I 5 866.44	9	10
II 3 641.34	4	10	I 4 536.05	6r	4	I 5 899.29	9	10
I 3 642.68 p	10r	3	I 4 544.70	9	3	I 5 918.54	6	3
I 3 653.50 P	10r	4	I 4 548.77	9	3	I 5 922.10	7	4
II 3 659.77	4	10	II 4 549.63	5	10	I 5 941.75	7	4
II 3 662.24	4	10	I 4 555.49	9	3	I 5 953.16	8	10
II 3 685.19	10r	10	II 4 563.77	4	10	I 5 965.82	8	10
II 3 706.22	2	8	II 4 571.98	6	10			

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

Titanium (Continued)

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.
I 5 978.54	8	8	I 6 258.72	9	9	I 7 209.45	8	....
I 5 999.67	6	2	I 6 261.10	9	9	I 7 244.86	5	....
I 6 085.24	7	4	I 6 303.77	6	3	I 7 251.7	6	....
I 6 091.18	7	5	I 6 556.09	6	5	I 8 426.5	4	....
I 6 126.22	9	5	I 6 743.15	5	3	I 8 435.6	5	....
I 6 215.26	7	10	I 6 861.17	5	1	I 8 518.2	4	....
I 6 258.11	9	9						

Tungsten

1 550.2	..	3	2 946.98	8r	3	5 071.74	5	10
1 679.2	..	3	3 017.44	6r	2	5 224.68	10	10
1 785.5	..	5	3 041.86	5r	1	5 492.34	10	10
1 787.0	..	5	3 046.44	5r	1	5 514.72	10	10
1 788.3	..	5	3 049.68	6r	1	5 648.39	7	10
1 895.5	..	6	3 077.50	1	10	5 735.10	8	8
2 397.11 p	2	10	3 376.14	1	10	5 804.86	7	5
2 446.4	1	8	3 401.90	1	8	5 947.58	4	2
2 488.8	2	6	3 508.74	6	5	6 012.80	4	3
2 571.46	2	6	3 545.23	6	3	6 292.05	4	2
2 572.3	..	6	3 572.47	3	10	6 404.22	4	2
2 579.3	1	5	3 592.42	3	10	6 445.15	4	2
2 579.6	..	7	3 613.79 p	3	10	6 538.15	4	....
2 589.14 p	2	8	3 617.52	8r	2	6 693.12	5	....
2 658.02	2	8	3 641.41	4	10	6 820.7	4	....
2 702.1	1	10	3 736.24	1	10	6 934.28	4	....
2 762.34	4r	2	3 867.98	5	5	6 984.29	4	....
2 764.28	4r	8	4 008.76 P	10	10	7 140.51	3	....
2 768.99	4r	1	4 074.37	7	6	7 296.57	3	....
2 769.76	4r	1	4 215.38	3	8	7 385.08	3	....
2 770.90	4r	1	4 294.62 p	6r	9	7 483.34	3	....
2 774.01	5r	2	4 302.12 p	8	5	7 569.87	3	....
2 774.48	5r	3	4 434.20	8	4	7 614.07	3	....
2 818.07	5r	2	4 570.66	7	3	7 688.93	3	....
2 879.11	5r	2	4 588.74	7	3	7 784.11	3	....
2 879.40	5r	2	4 680.52	8	5	7 940.92	3	....
2 896.01	4r	2	4 843.83	9	5	8 123.78	3	....
2 896.44	6r	3	5 006.17	8	10	8 585.07	3	....
2 934.99	5r	3	5 015.34	8	8	8 594.38	3	....
2 944.41	7r	3	5 053.30	10	2	8 613.22	3	....

Uranium

397.	..	1	4 090.13	6	4	4 731.60	5	3
764.	..	5	4 156.65	5	2	4 756.79	5	2
1 587.	..	5	4 163.70	5	2	4 772.70	4	3
1 833.	..	5	4 171.61	5	3	4 819.48	4	2
1 981.	..	5	4 241.68 p	5	4	4 899.27	4	2
1 985.	..	5	4 287.87	4	3	5 027.38	5	4
2 008.	..	5	4 341.67	5	4	5 280.38	4	1
3 566.61	4	2	4 393.60	5	2	5 475.71	5	3
3 670.07	4	3	4 472.34	5	6	5 481.20	5	3
3 831.45	4	3	4 543.64	5	8	5 492.94	8	4
3 859.57	5	3	4 627.08	5	5	5 527.84	10	4
3 932.04	5	3	4 646.60	4	4	5 564.16	5	1
3 985.80	5	2	4 689.07	5	4	5 610.88	5	1

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

URANIUM (Continued)

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.
5 621.50	4	1	6 372.46	5	....	7 881.91	4	....
5 669.45	4	....	6 395.46	6	....	7 970.44	3	....
5 723.63	5	1	6 449.19	10	1	8 223.08	4	....
5 758.18	6	....	6 465.00	4	....	8 262.09	4	....
5 780.56	4	....	6 826.90	4	....	8 318.4	3	....
5 798.54	4	1	7 074.78	4	....	8 381.93	3	....
5 837.7	4	1	7 101.61	3	....	8 445.38	4	....
5 915.39	8	1	7 128.88	4	....	8 450.04	4	....
5 976.32	5	....	7 425.49	3	....	8 496.10	3	....
5 997.32	4	....	7 533.91	5	....	8 504.66	4	....
6 051.74	4	1	7 619.34	3	....	8 540.17	3	....
6 077.28	4	....	7 631.72	3	....	8 607.92	5	....
6 171.88	4	....	7 784.11	5	....	8 691.26	3	....

VANADIUM

483.0	..	5	II 2 952.08	8	8r	3 457.13	2	10
684.5?	..	5	2 955.80	8	....	3 496.94	3	8
723.	..	3	II 2 957.52	8	6	3 504.44	4	10
1 112.	..	2	2 968.38	8	10r	3 517.30	5	10
1 437.3	..	2	2 974.24	8	1	3 524.73	3	8
1 454.	..	2	2 976.21	8	2	3 530.77	6	10
2 074.5	..	15	2 976.53	8	3	3 545.20	6	10
2 677.83	7	4	2 977.55	8	1	3 556.80	4	10
2 678.60	7	3	2 989.59	1	3r	3 566.17	3	8
2 679.35	8	4	3 001.20	3	8r	3 589.75	5	10
2 687.99	10	5r	3 044.93	4r	1	3 592.02	5	10
2 700.96	8	5r	3 050.88	3r	3	3 593.33	5	10
2 706.19	8	3r	3 056.35	3r	2	3 618.95	1	8
2 715.69	10	5	3 060.45	3r	....	3 667.72	8	3
2 762.6	..	2r	3 066.37	4r	1r	3 669.42	1	8
2 810.24	2	8	II 3 093.14 P	4	10r	I 3 688.07	8	3
2 882.51	6	8	II 3 102.30 p	10	10r	I 3 690.29	8	4
2 882.51	6	8	II 3 110.71 p	8	10r	I 3 692.22	8	4
2 884.79	6	10	II 3 118.38 p	10r	10r	3 695.87	8	3
2 891.65	10	6r	II 3 125.29 p	8	2	3 700.34	1	8
2 892.46	10	....	II 3 126.21	6	4r	I 3 703.57	8	3
2 892.67	10	5r	II 3 130.27	5	10r	3 715.47	6	10
2 893.32	10	5r	3 134.93	2	8	3 727.46	..	10
2 904.13	8	1	3 136.51	2	8	3 732.75	5	10
2 906.13	8	4r	3 139.73	1	8	3 745.80	3	10
II 2 907.47	8	3r	I 3 183.42 p	10r	2r	3 770.97	3	10
2 908.81	8r	8r	I 3 183.99 P	10r	2r	3 787.15	2	8
2 910.02	8	4r	I 3 185.41 p	10r	2r	3 794.96	8	3
2 910.39	8	4r	3 187.70	5	8r	I 3 813.50	8	3
II 2 911.06	6	3r	3 188.51	5	8r	3 815.51	3	10
2 914.93	10	2	3 190.67	7	10r	I 3 818.24	8	3
2 919.99	8	2	3 198.10	5r	2	3 847.32	4	10
II 2 420.38	8	3	I 3 202.38	5r	2	I 3 855.85	9r	3
2 923.63	8r	....	3 217.11	6	10	I 3 864.86	8	3
II 2 924.02	8	8r	3 237.87	6	10	I 3 875.08	8r	2
II 2 924.65	8	8r	3 254.75	2	8	3 878.73	1	10
II 2 930.81	8	5r	3 267.71	10	10r	3 902.26	8r	2
II 2 941.43	3	10r	3 271.11	10	10r	I 3 909.88	6r	....
2 942.35	10r	2	3 276.12	10	10r	3 914.31	2	8
2 943.20	8	1	3 279.84	3	10	3 916.40	2	8
II 2 944.6	2	8r	3 337.9	..	8	3 951.96	3	10

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

Vanadium (Continued)

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.
3 973.64	3	10	I 4 408.52	6r	10r	5 670.87	9	8
3 990.57	10	6	4 416.61	..	10	I 5 698.53	10r	10
3 997.13	3	8	I 4 421.59	8	5	I 5 703.61	10r	10
3 998.73	8	4	I 4 437.84	8	6	I 5 707.02	8r	9
4 005.71	3	10	I 4 441.69	7	8	I 5 727.04	10r	10
4 023.38	2	10	I 4 444.22	8	8	5 731.28	8	5
4 035.62	2	10	4 452.03	8	10	I 5 737.07	7	7
I 4 090.59	10	10	I 4 460.31	10r	10r	I 6 039.74	10	10
I 4 092.69	10	3	4 462.37	9	9	I 6 081.47	10	6
I 4 099.80	10	2	4 469.71	8	8	I 6 090.24	10r	10
I 4 105.17	10	4	4 488.90	8	10	I 6 111.67	10	9
I 4 115.18	10	2	4 545.40	9	8	I 6 119.54	10r	8
I 4 116.48	8	7	4 549.65	6	8	6 199.20	8	8
I 4 116.70	10r	7	4 560.72	7	9	I 6 216.35	8	10
I 4 128.07	10	10	4 571.79	6	10	I 6 230.78	10	9
I 4 132.00	10r	10	I 4 577.17	8	8	I 6 242.85	4	10
I 4 134.47	9	10	I 4 580.40	8	9	I 6 243.10	9	4
4 183.4	2	10	I 4 586.37	8	9	I 6 251.83	9	8
4 202.44	1	8	I 4 594.10	10r	10	I 6 268.85	5	5
4 205.08	2	10	I 4 619.68	8	9	I 6 274.67	5	8
I 4 209.85	6	8	4 776.48	6	9	I 6 285.18	9	7
4 268.64	8	8	I 4 786.52	6	8	I 6 292.83	9	7
4 271.56	6	8	I 4 796.94	7	8	I 6 296.53	10	6
4 276.96	6	8	I 4 807.56	10	8	6 326.87	5	4
4 284.06	7	10	I 4 851.50	9	8	I 6 452.38	4	....
I 4 330.03	6	10	I 4 864.75	10r	9	I 6 504.18	4	4
I 4 332.83	8	10	I 4 875.48	10r	10	I 6 531.43	10	6
I 4 341.01	9	10	I 4 881.57	10r	10	6 753.03	4	....
I 4 352.88	10	6	5 128.54	8	9	7 338.90	4	....
I 4 379.24	10r	10r	5 138.44	6	10	I 8 116.76	5	....
I 4 384.73	10r	10r	5 194.85	4	8	I 8 161.03	4	....
I 4 389.99	10r	10r	5 401.95	7	8	8 203.0	4	....
I 4 395.24	10	10	5 415.28	10	8	8 241.6	4	....
I 4 400.59	9	10	5 487.9	5	8	8 253.5	4	....
I 4 406.65	8r	5r	5 507.75	5	8	8 255.8	4	....
I 4 407.65	8r	4r	I 5 627.66	8	9	8 919.8	3	....
I 4 408.21	6r	1						

Xenon, First Spectrum

Wave length.	Geissler tube.	Wave length.	Geissler tube.	Wave length.	Geissler tube.
3 650.2	4	4 624.28? p	9	6 469.70	3
3 951.0	10	4 671.23? p	10	6 727.90	3
3 967.6	4	4 697.02	6	6 882.07	3
4 078.8	10	4 734.15	8	7 285.36	3
4 109.7	5	4 807.02	7	7 393.80	3
4 116.1	7	4 829.71	4	7 642.04	4
4 193.5	8	4 844.33	10	8 231.62	10
4 500.98 p	8	4 923.25	5	8 280.08	10
4 524.68?	6	6 182.44	2	8 409.17	4
4 582.75?	4	6 318.06	3	8 819.38	6
4 603.03	10				

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

Xenon, Second Spectrum (Continued)

Wave length.	Geissler tube.	Wave length.	Geissler tube.	Wave length.	Geissler tube.
2 475.9	10	3 596.6	5	4 585.5	10
2 605.6	10	3 624.1	8	4 592.0	6
2 677.2	8	3 676.6	7	4 603.0	10
2 717.4	7	3 776.3	7	4 652.0	6
2 794.9	5	3 781.0	10	4 698.0	5
2 814.5	6	3 841.5	7	4 823.3	6
2 816.0	5	3 877.8	8	4 844.3	10
2 871.2	5	3 880.5	6	4 862.5	8
2 937.9	6	3 895.0	6	4 876.5	7
2 957.7	5	3 907.9	7	4 883.5	6
2 979.4	6	3 922.5	10	4 890.1	5
2 993.0	5	3 950.6	8	4 921.5	6
3 065.2	6	3 992.7	5	5 080.7	7
3 083.6	6	4 050.0	6	5 292.2	10
3 091.1	5	4 057.4	5	5 314.0	8
3 138.3	6	4 109.0	6	5 339.4	9
3 150.7	6	4 180.0	10	5 372.4	8
3 151.0	6	4 193.1	8	5 419.2	10
3 196.2	5	4 208.5	6	5 439.0	8
3 239.3	6	4 238.2	10	5 460.4	6
3 242.8	7	4 245.4	10	5 472.7	7
3 285.8	8	4 330.5	10	5 531.1	7
3 322.2	6	4 393.2	10	5 616.8	6
3 330.8	6	4 395.7	10	5 659.5	5
3 454.3	7	4 414.8	7	5 667.6	6
3 458.8	5	4 434.2	6	5 719.6	6
3 467.2	5	4 448.1	10	5 751.1	5
3 468.2	5	4 462.2	10	5 976.5	7
3 542.4	6	4 480.8	7	6 036.2	6
3 552.1	6	4 540.9	8	6 051.2	7
3 579.7	6	4 545.2	8	6 097.6	7
3 583.6	6	4 577.2	6	6 557.	10

Ytterbium

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.
2 464.53	10r	....	3 126.1	..	10	3 619.83	5	8
2 642.53	1	8	3 140.91	4	10	3 694.20 p	10	10
2 672.64	3	4	3 153.86	3	10	3 770.09	7	3
2 750.49	5	10	3 169.05	3	8	3 795.76	3	5
2 851.17	4	10	3 192.87	3	8	3 988.01 p	10	10
2 859.81	3	6	3 289.37 p	10	10	4 135.13	4	8
2 914.23	2	10	3 337.17	8	2	4 180.84	10	5
2 919.36	4	10	3 342.96	10	5	4 316.96	2	5
2 970.56	6	5	3 362.60	10	4	4 439.22	8	2
2 994.80	3	8	3 431.12	6	3	4 576.22	10	3
3 005.76	5	10	3 441.50	10	3	4 726.07	8	10
3 009.39	3	8	3 454.07	5	10	4 781.90	8	....
3 017.57	3	10	3 464.33	10	5	4 786.60	10	10
3 029.6	..	10	3 476.30	8	4	4 935.51	10	....
3 031.12	10	5	3 478.84	8	10	5 277.07	6	....
3 065.03	4	10	3 520.24	4	10	5 335.14	6	1
3 107.87	10	10r	3 560.33	8	3	5 352.94	5	1
3 117.78	4	10	3 560.69	8	5	5 481.95	8	....

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

Ytterbium (Continued)

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.
5 539.05	10	....	5 837.13	8	....	6 799.66	10	...
5 556.47	10	1	6 489.14	10	1	7 527.58	5	.
5 652.00	9	....	6 667.85	10	....	7 699.49	10	...
5 720 02	10	....						

Yttrium

2 367.2	..	10	I 4 174.14	7	4	5 527.55	6r	3
2 414.7	..	10	II 4 177.52	10	10	II 5 544.60	5	2
2 422.20	4	8	4 220.62	7	1	5 556.45	4r	1
2 817.0	1	10	II 4 235.71	8	5	5 577.42	4r	1
2 946.0	..	10	4 251.18	7	2	5 581.88	5r	2
II 3 095.88	6	2	4 302.30	10	3	5 630.13	6r	2
3 129.93	3	8	II 4 309.62	10	10	5 644.69	4r	1
3 173.05	4	10	4 348.79	9	3	5 648.46	4r	1
II 3 195.61	8	10	II 4 358.72	7	10	5 662.95	7r	10
II 3 200.26	7	10	II 4 374.95	10	10	5 706.73	4r	2
II 3 203.32	7	10	II 4 398.03	8	10	II 5 728.90	4	2
II 3 216.67	10	10	II 4 422.60	10	10	II 5 781.68	4	2
II 3 242.28	10	10	4 505.96	8	3	5 945.72	4	1
II 3 327.88	10	10	4 527.26	8	5	6 009.20	5	3
3 361.99	5	10	4 527.79	7	3	I 6 023.42	4	2
3 496.09	9	10	I 4 643.69 p	8	5	I 6 138.45	4	2
3 548.99	10	10	4 658.31	6	3	I 6 191.72	7	4
3 584.51	4	10	I 4 674.84 P	8	5	I 6 222.58	6	2
I 3 592.91	8	4	II 4 682.31	5	10	I 6 435.03	8	8
II 3 600.73	10	10	II 4 823.31	4	10	6 538.58	4	2
II 3 601.92	10	10	4 839.86	9	10	II 6 613.75	5	3
II 3 611.05	10	10	4 845.68	6	5	6 664.37	4	....
I 3 620.94	10	8	4 852.69	6	4	I 6 687.57	5	1
3 668.48	3	10	II 4 854.88	10	10	6 700.71	4	1
II 3 710.30 P	10	10	4 859.83	6	3	6 735.99	4	....
II 3 747.55	6	10	II 4 883.69	10	10	I 6 793.71	4	1
II 3 774.33 p	10	10	II 4 900.12	10	10	II 6 795.41	4	1
II 3 788.69 p	9	10	II 5 087.42	10	10	6 845.23	4	....
II 3 950.35	10	10	II 5 123.21	6	4	6 887.22	4	....
II 3 982.61	10	10	II 5 200.41	10	10	6 950.32	4	....
I 4 047.65	7	4	II 5 205.71	10	10	II 6 951.67	4	....
I 4 077.38	6r	5	II 5 402.78	5	8	6 979.87	4	....
I 4 083.71	7	3	5 466.46	10	3	7 191.65	3	....
I 4 102.38	9r	8	II 5 497.41	5	8	II 7 264.16	4	....
I 4 128.32	8r	8	5 503.45	8	2	7 346.3	4	....
I 4 142.87	8r	8	II 5 509.91	9	4	II 7 450.2	4	....
I 4 167.52	8	4	II 5 521.62	6r	3	II 7 881.7	2	....

Zinc

677.9	..	5	1 651.9	..	7	1 839.3	..	6
I 1 457.	..	8	1 673.2	..	7	1 864.	..	5
I 1 589.	..	10	1 707.	..	7	II 2 025.5 P	4	2r
I 1 601.2	..	6	1 743.	..	10	II 2 061.9 p	4	4r
1 620.0	..	6	1 746.	..	8	II 2 100.0	..	5
1 622.9	..	7	1 750.	..	7	I 2 138.5 P	3r	2r
1 629 4	..	9	1 767.8	..	7	2 246.8	4	..
1 639 5	..	9	1 811.	..	7	2 393.80	4	1
1 645.0	..	8	1 834.	..	7	I 2 491.5	6	1

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

Zinc (Continued)

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.
II 2 502.0	3	10	II 3 806.39	..	10	II 6 482.98	..	15
II 2 557.95	8	10	II 3 840.34	..	15	I 6 928.4	8	....
I 2 569.92	6r	1	4 057.87	6	1	I 6 938.5	6	....
II 2 570.72	..	2r	I 4 629.81	8	....	I 6 943.4	4	....
I 2 582.5	8r	2	I 4 680.14	10r	10	7 026.1	4	....
I 2 608.6	8r	3	I 4 722.16	10r	10	7 264.2	4	....
I 2 670.57	4	1	I 4 810.53	10r	10	7 338.9	4	....
I 2 684.19	6	3	II 4 911.6	10	25	II 7 478.73	4	20
I 2 712.50	6	3	II 4 924.0	10	30	II 7 588.61	..	15
I 2 756.47	6r	5	I 5 181.95	5	1	II 7 732.63	..	10
I 2 770.9	8r	8	I 5 308.57	8	....	I 7 799.1	4	....
I 2 771.0	6r	....	I 5 310.18	6	....	I 10 970.	4	....
I 2 800.0	8r	....	I 5 310.90	4	....	I 10 979.	4	....
I 2 800.8	7r	10	I 5 772.2	8	....	I 11 054.2	10	....
I 2 802.0	3r	....	I 5 775.6	6	....	I 13 053.2	10	....
I 3 018.38	6	3	I 5 777.1	5	....	I 13 150.4	10	....
I 3 035.80	10r	6	II 5 894.39	8	20	I 13 197.5	10	....
I 3 072.10	10r	10	II 6 021.26	1	15	I 13 781.4	2	....
I 3 075.88	8r	6	II 6 102.54	2	20	I 13 786.1	4	....
I 3 282.30 p	8r	10	II 6 111.56	..	10	I 14 038.5	10	....
I 3 302.6 p	8r	10	II 6 214.65	..	12	I 15 679.7	4	....
I 3 302.9	8r	10	I 6 237.9	6	....	I 16 485.7	4	....
I 3 345.0 p	10r	10	I 6 239.20	5	....	I 16 503.9	4	....
I 3 345.6	8r	10	I 6 362.35	10	10	16 504.0	4	....
I 3 345.9	8	2	I 6 479.0	7	....			

Zirconium

2 449.84	4	3	II 3 572.47 p	10	10	I 4 710.07 p	10	5
2 568.87	5	6	II 3 576.86	7	10	I 4 739.48 p	9	5
2 571.41	6	8	3 611.89	4	8	I 4 772.32 p	8	4
2 678.64	5	5	II 3 614.77	6	10	I 4 815.63 p	6	3
2 734.84	5	5	II 3 674.71	6	10	4 909.57	6	....
2 752.21	4	3	3 698.16	6	10	4 959.41	5	....
2 844.58	4	4	3 709.27	6	10	5 046.58	5	1
2 875.98	4	....	3 751.59	6	10	5 064.90	5	1
2 968.95	6	3	3 796.49	3	8	5 155.44	4	1
2 985.39	4	1	I 3 835.97	7	2	5 191.58	4	....
3 011.74	5	1	II 3 836.75	5	10	5 311.39	5	1
3 029.52	6	1	I 3 890.32	7	4	5 385.12	7	1
3 106.57	6	4	3 915.93	5	10	5 502.13	6	1
I 3 182.87	7	5	II 3 958.22	8	10	5 528.39	5	1
II 3 273.05	8	9	3 991.13	9	10	5 620.13	6	1
II 3 279.27	8	4	II 3 998.97	9	10	I 5 680.88	6	1
3 284.71	8	4	4 048.67	7	9	5 879.77	8	1
3 356.09	8	4	I 4 081.21	9	5	I 6 127.44	7	1
II 3 357.26	8	4	4 149.20	10	10	I 6 143.19	7	1
II 3 391.98 P	10	10	4 156.23	8	9	6 299.63	7	1
II 3 430.53	7	9	4 161.21	7	8	6 313.01	7	1
II 3 438.23 p	10	10	I 4 227.75	8	4	6 470.21	6	1
3 463.01	4	10	I 4 282.20	6	6	6 489.64	6	1
3 479.39	7	9	4 347.89	7	3	6 769.12	6	....
3 481.15	8	10	4 379.77	8	10	6 846.95	4	....
II 3 496.21 p	10	10	4 442.99	6	9	6 953.83	5	....
3 505.48	4	8	I 4 535.75	8	3	6 990.82	5	....
II 3 505.66	5	8	4 575.51	7	3	I 7 097.7	4	....
I 3 519.60 P	8	3	4 633.98	7	2	I 7 169.1	6	....
3 542.62	5	10	I 4 687.80 p	10	5	7 280.3	4	....
II 3 556.60	9	10	4 688.45	7	4	7 318.2	3	....

SPARK SPECTRUM OF AIR

INTERNATIONAL ÅNGSTROMS

Wave length	Intensity	Element	Wave length	Intensity	Element	Wave length	Intensity	Element
2 287.9	1	N	3 727.34	4	O	4 145.90	3	N
2 318.5	1	O	3 729.3	1	N	4 153.5	3	O
2 382.1	2	....	3 749.51	5	O	4 169.36	1	O
2 395.62	1	....	3 754.5	1	O	4 176.2	2	N
2 399.	1	....	3 759.8	1	O	4 185.5	4	O
2 404.9	2	....	3 770.9	1	N	4 189.8	6	O
2 406.9	1	....	3 804.0	1	O	4 199.3	0	N
2 433.6	1	O	3 830.7	1	N	4 206.7	2	N
2 445.5	1	O	3 839.1	2	N	4 211.1	1	N
2 507.2	2	....	3 842.8	1	N	4 223.3	1	N
2 514.5	1	....	3 845.1	0	N	4 228.	2	N
2 599.5	2	....	3 848.04	1	O	4 236.8	3	N
2 739.8	1	....	3 850.6	1	N	4 241.75	2	O
2 746.7	1	....	3 851.2	1	O	4 253.7	2	N
2 749.	1	....	3 856.7	1	N	4 266.4	2	N
2 755.9	2	....	3 864.6	1	O	4 275.9	1	N
2 795.5	1	....	3 882.3	2	O	4 303.7	1	O
2 858.3	1	....	3 893.3	1	N	4 317.11	3	O
2 927.5	1	....	3 907.6	1	O	4 319.62	3	O
3 007.	1	O	3 909.1	1	N	4 325.7	1	O
3 047.0	1	....	3 912.1	3	O	4 327.5	1	O
3 059.15	2	....	3 919.10	6	N	4 328.5	1	O
3 130.1	1	....	3 933.6	9	?	4 331.04	1	N
3 135.3	1	O	3 940.2	1	N	4 331.9	1	O
3 139.3	2	O	3 945.1	1	O	4 336.8	2	O
3 158.7	1	....	3 947.45	1	O	4 345.54	3	O
3 265.2	1	O	3 954.4	1	O	4 347.44	2	O
3 288.9	1	....	3 955.9	4	N	4 348.0	2	N
3 301.9	1	....	3 968.4	1	A(?)	4 349.40	4	O
3 312.5	1	O	3 973.30	4	O	4 351.3	2	O
3 318.8	1	....	3 982.76	2	O	4 361.6	0	N
3 320.7	2	O	3 995.1	10	N	4 366.87	3	O
3 325.	1	O	4 014.0	1	O	4 369.2	1	O
3 329.5	2	N	4 025.7	1	N	4 371.4	1	N
3 331.8	2	N	4 034.9	2	N	4 379.6	1	N
3 344.8	1	....	4 041.3	3	N	4 392.4	0	N(?)
3 354.08	1	O	4 057.8	1	N	4 396.0	1	O
3 365.8	1	N	4 063.2	1	N	4 401.2	1	N
3 367.3	1	N	4 069.90	8	O	4 414.9	6	O
3 370.9	1	N	4 072.25	8	O	4 417.0	5	O
3 374.0	2	N	4 075.93	8	O	4 425.9	1	O
3 377.2	2	O	4 078.9	2	O	4 430.1	1	N
3 390.3	2	O	4 085.20	2	O	4 432.4	2	N
3 408.3	2	O	4 089.1	1	O	4 434.0	0	N
3 437.32	3	N	4 093.00	2	O	4 443.3	1	O
3 450.9	1	....	4 097.2	3	N	4 447.04	6	N
3 471.2	2	....	4 103.3	2	N	4 452.4	2	O
3 491.9	2	....	4 105.00	3	O	4 460.1	1	N
3 514.8	1	....	4 110.84	2	O	4 465.4	2	O
3 560.6	1	....	4 112.09	1	O	4 467.8	2	O
3 570.3	1	....	4 114.0	0	O	4 469.4	1	O
3 577.2	1	....	4 119.3	4	O	4 477.7	1	N
3 589.0	1	....	4 120.5	2	O	4 507.62	2	N
3 594.6	1	....	4 121.5	2	O	4 514.8	2	O
3 609.8	1	....	4 124.1	2	O	4 529.9	2	N
3 639.6	3	....	4 129.5	1	O	4 544.8	1	N
3 702.9	1	....	4 132.88	2	O	4 552.5	2	N
3 707.3	1	O	4 133.70	2	N	4 590.93	3	O
3 709.2	1	O	4 142.2	1	O	4 596.12	3	O
3 712.7	2	O	4 143.7	1	O	4 601.48	4	N

SPARK SPECTRUM OF AIR (Continued)

INTERNATIONAL ANGSTROMS

Wave length	Intensity	Element	Wave length	Intensity	Element	Wave length	Intensity	Element
4 607.14	4	N	5 016.4	2	N	5 952.4	4	N
4 609.4	1	N	5 022.9	1	N	6 158.1	0	O
4 613.84	3	N	5 025.7	2	N	6 171.0	2	O
4 621.39	4	N	5 032.	0	....	6 284.3	1	N
4 630.53	10	N	5 045.1	2	N	6 341.5	0	N
4 634.0	1	N	5 061.8	0	N	6 358.1	0	N
4 638.8	2	O	5 073.5	0	N	6 370.7	0	....
4 640.5	1	N	5 136.	0	....	6 379.3	2	N
4 641.8	3	O	5 143.6	0	O	6 456.	0	O
4 643.1	4	N	5 150.	0	....	6 482.0	5	N
4 649.1	4	O	5 160.1	0	O	6 563.2	3	H
4 650.8	2	O	5 172.	1	N	6 610.4	6	N
4 654.5	1	N	5 173.4	1	N	6 640.7	0	....
4 661.6	5	O	5 175.9	2	N	6 654.8	2	....
4 674.9	1	N	5 179.4	1	N	6 721.3	1	....
4 676.2	3	O	5 183.2	0	O	6 811.9	0	....
4 697.6	0	N(?)	5 185.1	0	N	6 864.	0	....
4 699.2	3	O	5 190.6	1	N	6 887.6	1	....
4 703.1	0	O	5 206.5	1	O	6 950.	0N	....
4 705.1	1	N	5 250.6	1	N(?)	6 965.9	1	A
4 705.4	3	O	5 263.	0	....	7 067.6	0	A
4 709.9	2	O	5 281.7	0	N	7 157.4	9	O(?)
4 718.4	2	N	5 320.5	1	N	6 384.5	1	A
4 735.7	1	N	5 325.1	0	O	7 424.0	8	N
4 751.2	1	O	5 328.6	0	N	7 432.9	0	....
4 764.6	1	N	5 338.7	1	N	7 442.7	10	N
4 774.2	1	N	5 341.2	1	N	7 458.7	0	....
4 779.8	2	N	5 351.2	0	N	7 468.7	10	N
4 781.2	0	N(?)	5 356.4	0	N	7 479.	0	O
4 788.2	4	N	5 411.5	1	N	7 505.8	0	A
4 793.7	2	N	5 432.1	0	N(?)	7 515.2	0	A
4 803.3	5	N	5 452.1	1	N	7 635.7	1	A
4 805.9	1	N	5 454.1	1	N	7 772.1	10	O
4 810.3	2	N	5 462.8	1	N	7 774.3	7	O
4 847.7	1	N(?)	5 478.1	0	N	7 775.6	6	O
4 856.8	1	O	5 480.1	1	N	7 947.8	4	O
4 860.3	1	N	5 495.7	2	N	7 951.1	3	O
4 871.6	0	O	5 526.2	2	N	7 952.3	2	O
4 879.7	1	N	5 530.2	3	N	8 185.3	4	N
4 890.9	0	O	5 535.2	5	N	8 188.4	4	N
4 895.3	1	N	5 543.4	3	N	8 200.7	1	N
4 906.8	1	O	5 552.0	2	N	8 211.1	2	N
4 924.6	2	O	5 566.	0	N	8 216.7	7	N
4 934.8	1	N	5 592.3	0	O	8 223.5	4	N
4 941.0	1	N	5 645.6	1	N	8 230.2	0	O
4 942.5	1	N	5 666.6	5	N	8 242.8	4	N
4 943.0	1	O	5 675.9	3	N	8 446.8	5	O
4 955.	1	O	5 679.5	10	N	8 594.	0	....
4 964.7	0	N	5 686.2	3	N	8 630.0	0	....
4 987.4	1	N	5 710.7	2	N	8 680.6	2	N
4 991.3	1	N	5 730.6	2	N	8 683.7	1	N
4 994.4	3	N	5 747.5	1	N	8 686.4	0	N
5 001.4	6	N	5 767.4	2	N	8 692.	0	....
5 005.2	6	N	5 927.8	4	N	8 703.8	0	N
5 007.4	3	N	5 931.8	7	N	8 712.0	0	N
5 010.6	2	N	5 940.5	1	N	8 719.2	0	N
5 013.9	0	....	5 941.6	10	N			

STANDARD WAVE LENGTHS

Primary Standard

Wave length of the red cadmium line in air, 760 mm. pressure 15°C., measures of Benoit, Fabry and Perot 1907,
6438.4696 Ångström units

SECONDARY STANDARDS. Lines of the Iron Arc

Selected lines from list by Ch. Fabry: *International Critical Tables*, 1929. Wave lengths in international Ångströms, atmospheric pressure, 15°C.

Wave-length	Wave-length	Wave-length	Wave-length	Wave-length
3370.789	3935.816	4592.655	5232.948	6065.489
3399.337	3977.744	4602.945	5266.564	6137.697
3485.343	4021.870	4647.437	5371.493	6191.563
3513.821	4076.638	4691.414	5405.779	6230.729
3556.882	4118.549	4707.282	5434.527	6265.141
3606.682	4134.680	4736.782	5455.613	6318.023
3640.392	4147.673	4789.654	5497.520	6335.338
3676.314	4191.436	4878.219	5506.783	6393.606
3677.630	4233.609	4903.318	5569.626	6430.852
3724.381	4282.406	4919.001	5586.763	6494.985
3753.615	4315.087	5001.872	5615.652	6546.245
3805.346	4375.933	5012.072	5658.825	6592.920
3843.261	4427.313	5049.825	5709.396	6677.994
3850.820	4466.556	5083.343	5763.013	6750.157
3865.527	4494.568	5110.414	5857.759 Ni	
3906.482	4531.152	5167.491	5892.882 Ni	
3907.937	4547.851	5192.353	6027.058	

SECONDARY STANDARDS

Spectra of helium, neon, argon, krypton and xenon. Comparison with the primary standard made by interferometer methods. Wave lengths in Ångström units.

Helium

Merrill, Bulletin 14, Bulletin of Standards 1917.

2945.104	3888.646	4387.928	5047.736
3187.743	3964.727	4471.479	5875.620
3613.641	4026.189	4713.143	6678.149
3705.003	4120.812	4921.928	7065.188
3819.606	4143.759	5015.675	7281.349

STANDARD WAVE LENGTHS (Continued)

Neon

Burns, Meggers, Merrill, Bulletin 14, Bureau of Standards, 1918
Meissner, Annalen der Physik, 1919

Bureau of Standards	Meissner	Bureau of Standards	Meissner
3369.904	.....	6402.245	.2460
3417.906	.....	6506.528	.527
3447.705	.....	6532.883	.881
3454.197	.....	6598.953	.953
3460.526	.....	6678.276	.275
3464.340	.....	6717.043	.042
3466.581	.....	6929.468	.455
3472.578	.....	7024.049	....
3498.067	.....	7032.413	.410
3501.218	.....	.....	.....
3515.192	.....	7051.292	7051.314
3520.474	.....	7059.109	7059.119
3593.526	.....	7173.938	7173.938
3593.634	.....	7245.166	7245.165
3600.170	.....	7438.899	7438.885
3633.664	.....	7488.872	.....
5330.779	.....	7535.784	7535.786
5341.096	.....	7544.050	7544.061
5400.562	.564	.....	7937.010
5764.419	.....	7943.182	7943.193
5820.155	.....	.....	8082.460
5852.488	.4875	.....	8118.554
5881.895	.896	8136.408	8136.423
5944.834	.834	.....	8259.392
5975.534	.534	.....	8266.092
6029.997	.999	8300.369	8300.338
6074.338	.337	8377.606	8377.630
6096.163	.163	.....	8418.447
6143.062	.061	8495.358	8495.359
6163.594	.594	.....	8591.266
6217.280	.279	.....	8634.668
6266.495	.495	.....	8654.380
6304.789	.788	.....	.....
6334.428	.428	.....	.....
6382.991	.991	.....	.....

STANDARD WAVE LENGTHS (Continued)

Argon

Meggers, Journal Optical Society of America, 1921

Bureau of Standards	Meissner	Bureau of Standards	Meissner
3948.980	4300.101	6871.290	7514.651
4044.419	4333.561	6937.666	7635.106
4158.591	4345.168	6965.429	7723.758
4164.180	4510.733	7030.250	7724.210
4181.884	4522.325	7067.217	2948.175
4190.714	4596.096	7147.042	8006.156
4191.027	4628.445	7206.986	8014.784
4198.316	4702.317	7272.935	8103.693
4200.676	6032.127	7353.316	8115.307
4251.184	6416.307	7372.119	8264.522
4259.362	6677.282	7383.979	8408.210
4266.286	6752.831	7503.867	8424.646
4272.169	.....	.....	8521.443

Krypton

Meggers, Journal Optical Society of America, 1921

Bureau of Standards	Meissner	Bureau of Standards	Meissner
4273.9696	4362.6422	4502.354	6456.290
4282.967	4376.122	4807.065	7587.414
4318.552	4399.969	5562.224	7601.544
4319.580	4453.9174	5570.2872	.....
4355.478	4463.690	5870.9137	.....

Xenon

Meggers, Journal Optical Society of America, 1921

4500.978	4624.275	4807.019
4524.680	4671.225	4829.705
4582.746	4697.020	4844.333
4603.028	4734.154	4923.246

INDEX OF REFRACTION OF OPTICALLY ISOTROPIC SOLIDS

The following table gives the index of refraction with reference to air for optically isotropic solids including minerals. Data for glass and certain other substances of special optical importance will be found in succeeding tables.

Substance.	Spectrum line or wave length.	Index of refraction.	Observer.
Agate	red	1.537	De Senarmont
		1.540	Kohlrausch
Alabandite, MnS	*Li*	2.700	
Albite glass	*D*	1.4890	Larsen, 1909
Almandite, $3FeO \cdot Al_2O_3 \cdot 3Si_1O_2$	*D*	1.81	Lacroix, 1893
	D	1.778	
Alum, aluminum ammonium	*D*	1.45939	Soret
aluminum caesium	*D*	1.45856	Soret
aluminum potassium	*D*	1.45645	Soret
aluminum rubidium	*D*	1.45660	Soret
aluminum sodium	*D*	1.43884	Soret
aluminum thallium	*D*	1.49748	Soret
chromium ammonium	*D*	1.48418	Soret
chromium caesium	*D*	1.48100	Soret
chromium potassium	*D*	1.48137	Soret
chromium rubidium	*D*	1.48151	Soret
chromium thallium	*D*	1.52280	Soret
iron ammonium	*D*	1.48482	Soret
iron caesium	*D*	1.48378	Soret
iron potassium	*D*	1.48169	Soret
iron rubidium	*D*	1.48234	Soret
iron thallium	*D*	1.52365	Soret
Amber	*D*	1.546	Mulheim
Ammonium chloride	*D*	1.6422	Grailich, 1858
iodide	*D*	1.7031	Topsoe, Christiansen
Ammonium and iron chloride	*D*	1.6439	Grailich
Amphigen, $K_2Al_2Si_4O_{12}$	*D*	1.5086	Zymanyi
Analcite, $Na_2O \cdot Al_2O_3 \cdot 4SiO_2 \cdot 2H_2O$	*D*	1.487	
Andradite, $3CaO \cdot Fe_2O_3 \cdot 3SiO_2$	*D*	1.857	
Anorthite glass	*D*	1.5755	Larsen, 1909
Arsenic disulfide, realgar, As_2S_2		2.454	Jamin
Arsenolite, arsenic trioxide, As_2O_3	*D*	1.755	Des Cloizeaux
Asphalt	.670	1.621	Nichols
	D	1.635	Nichols
Barium calcium propionate, $BaCa_2(C_3H_5O_2)_6$	*D*	1.4442	Fritz, Sassoni
Barium nitrate	*D*	1.5711	Topsoe, Christiansen
Bauxite, $Al_2O_3 \cdot nH_2O$	*D*	1.570	
Berselite, $3(Ca, Mg, Mn)O \cdot As_2O_5$	*D*	1.727	
Borax, amorphous fused	*C*	1.4624	Bedson, Williams
	D	1.4630	Bedson, Williams
	F	1.4702	Bedson, Williams
Boric acid, amorphous	*C*	1.4623	Bedson, Williams
	D	1.4637	Bedson, Williams
	F	1.4694	Bedson, Williams
Boric oxide, B_2O_3	*D*	1.4637	Bedson, Williams
Bromyrite, AgBr	*D*	2.253	
Bunsenite, NiO	*Li*	2.18	
Camphor	*D*	1.532	Kohlrausch
	D	1.5462	Mulheim
Canada balsam	*D*	1.530	

INDEX OF REFRACTION OF OPTICALLY ISOTROPIC SOLIDS (Continued)

Substance.	Spectrum line or wave length.	Index of refraction.	Observer.
Cerargyrite, AgCl	*D*	2.061	
Chromite, FeO, Cr_2O_3	*D*	2.070	
Cristobalite, SiO_2	*D*	1.486	
Cryolithionite, $3NaF \cdot 3LiF \cdot 2AlF_3$	*D*	1.339	
Cupric oxide, CuO	white	2.84	Kundt
Cuprite, Cu_2O	*D*	2.849	
Cuprous oxide, Cu_2O	*D*	2.705	Wernicke
Cyanine	*D*	1.71	Wood
Diamond	*D*	2.4173	Sella
Dysanlite, CaO, FeO, TiO_2, etc.	*D*	2.330	
Ebonite	red	1.66	Ayrton, Perry
	white	1.611	Jellet
Egglestonite, $HgO \cdot 2HgCl$	*Li*	2.490	
Embolite, Ag(Br, Cl)	*D*	2.150	
Eulytite, $2Bi_2O_3 \cdot 3SiO_2$	*D*	2.050	
Fluorite, CaF_2	*D*	1.434	
Franklinite, (Zn, Fe, Mn)O. $(Fe, Mn)_2O_3$	*Li*	2.360	
Fuchsin	*C*	2.33	Mean
	D	2.70	Coblentz
	G	1.97	Mean
	H	1.32	Mean
Gahnite, $ZnO \cdot Al_2O_3$	*D*	1.800	
Garnet	*D*	1.74	Mean
Gelatine, Nelson's No. 1	*D*	1.530	Jones, 1911
Grossularite, $3CaO \cdot Al_2O_3 \cdot 3SiO_2$	*D*	1.736	
Gum Arabic	red	1.480	Jamin
	red	1.514	Wollaston
Halite, NaCl	*D*	1.544	
Hauerite, MnS_2	*Li*	2.690	
Hauynite, $1Na_2O \cdot 3Al_2O_3 \cdot 6SiO_2 \cdot 2SO_2 \cdot CaO$	*D*	1.496	
Helvite, $3(Mn, Fe)O \cdot 3BeO \cdot 3SiO_2 \cdot MnS$	*D*	1.739	
Hercynite, $FeO \cdot Al_2O_3$	*D*	1.800	
Hessonite, $3CaO.(Al, Fe)_2O_3 \cdot 3SiO_2$	*D*	1.763	
Hoffman's violet	.671	2.53	Pflüger
	.589	2.20	Pflüger
	.535	1.27	Pflüger
	.486	0.86	Pflüger
	.434	1.32	Pflüger
Lazurite, $4Na_2O \cdot 3Al_2O_3 \cdot 6SiO_2 \cdot Na_2S$	*D*	1.500	
Lead nitrate, $Pb(NO_3)_2$	*D*	1.5716	Fock
Lead oxide, PbO		2.076	Jamin
Leucite, $K_2O \cdot Al_2O_3 \cdot 4SiO_2$	*D*	1.509	
Lewisite, $5CaO \cdot 2TiO_2 \cdot 3Sb_2O_5$	*D*	2.200	
Lime, CaO	*D*	1.830	
Magdala red	.671	2.06	Pflüger
	.589	1.90	Pflüger
	.535	1.56	Pflüger
Magnesium bromate, $Mg(BrO_3)_2 M + 6H_2O$	*D*	1.5139	Ortloff
Malachite green	.671	2.50	Pflüger
	.589	1.33	Pflüger
	.535	1.16	Pflüger

INDEX OF REFRACTION OF OPTICALLY ISOTROPIC SOLIDS (Continued)

Substance.	Spectrum line or wave length.	Index refraction.	Observer.
Manganioste, MnO	*D*	2.160	
Marshite, CuI	*D*	2.346	
Microlite, $6CaO \cdot 3Ta_2O_5 \cdot CbOF_3$	*D*	1.925	
Miersite, CuI·4AgI	*D*	2.200	
Mosesite, Hg, NH_4, Cl etc.	*D*	2.065	
Nantokite, CuCl	*D*	1.930	
Nickel oxide, NiO	white	2.23	Kundt
Noselite, $5Na_2O \cdot 3Al_2O_3 \cdot 6SiO_2 \cdot 2SO_2$	*D*	1.495	
Obsidian	*D*	1.4953	Kohlrausch
	D	1.4964	Mülheims
	D	1.4841	Corning
Opal, $SiO_2 \cdot nH_2O$	*D*	1.44807	Baille
	D	1.4536	Zymanyi
	D	1.45883	Brun
Periclasite, MgO	*D*	1.736	
Percylite, $PbO \cdot CuCl_2 \cdot H_2O$	*D*	2.050	
Perovskite, $CaO \cdot TiO_2$	*D*	2.380	
Pharmacosiderite, $3Fe_2O_3 \cdot 2As_2O_5 \cdot 3K_2O \cdot 5H_2O$	*D*	1.676	
Phosphorous	*D*	2.1442	Gladstone, Dale
Picotite, $(Mg, Fe)O \cdot (AlCr)_2O_3$	*D*	2.950	
Pitch	red	1.531	Wollaston
Pleonaste, $(Mg, Fe)O \cdot Al_2O_3$	*D*	1.770	
Pollucite, $2Cs_2O \cdot 2Al_2O_3 \cdot 9SiO_2 \cdot H_2O$	*D*	1.525	
Potassium bromide	*D*	1.5593	Topsoe, Christiansen
chloride	*D*	1.49038	Martens
chlorstannate	*D*	1.6574	Topsoe, Christiansen
iodide	*D*	1.6666	Topsoe, Christiansen
zinc cyanide, $2KCN \cdot Zn(CN)_2$	yellow	1.4115	Grailich
Pyrochlor, CaO, Ce_2O_3, TiO_2 etc.	*D*	1.960–2.000	
Quartz, fused	.656	1.45640	Giffard, Shenstone
	.589	1.45843	Giffard, Shenstone
	.509	1.46190	Giffard, Shenstone
	.361	1.47503	Giffard, Shenstone
	.275	1.49634	Giffard, Shenstone
	.214	1.53386	Giffard, Shenstone
	.185	1.57464	Giffard, Shenstone
Resin, aloes	red	1.619	Jamin
colophony	red	1.548	Jamin
copal	red	1.528	Jamin
mastic	red	1.535	Jamin
Rubidium bromide	*D*	1.5533	Craw
chloride	*D*	1.4928	Craw
iodide	*D*	1.6262	Leblanc, Erdmann
Schorlomite, $2CaO \cdot (Fe, Ti)_2O_3 \cdot 3(Si, Ti)O_2$	*D*	1.980	
Selenium	.760	2.612	Wood
	.656	2.729	
	.589	2.93	Wood
	.500	3.13	Wood
	.408	2.95	Wood
Senarmontite, Sb_2O_3	*D*	2.087	
Silver bromide	*D*	2.2536	Wernicke
chloride	*D*	2.0622	Wernicke
iodide	*D*	2.1816	Wernicke

INDEX OF REFRACTION OF OPTICALLY ISOTROPIC SOLIDS (Continued)

Substance.	Spectrum line or wave length.	Index of refraction.	Observer.
Sodalite, $3Na_2O \cdot 3Al_2O_3 \cdot 6SiO_3 \cdot 2NaCl$	*D*	1.483	
Sodium bromate	*D*	1.5943	Craw
chlorate	*D*	1.51523	Borel
chloride	*D*	1.5433	Borel
Spessartite, $3MnO \cdot Al_2O_3 \cdot 3SiO_2$	*D*	1.811	
Sphalerite, (Zn, Fe)S	*D*	2.37–2.47	
Spinel, $MgO \cdot Al_2O_3$	*D*	1.723	
Strontium nitrate	*D*	1.5667	Fock
Sylvite, KCl	*D*	1.490	
Uvarovite, $3CaO \cdot Cr_2O_3 \cdot 3SiO_2$	*D*	1.838	
Villiaumite, NaF	*D*	1.328	
Zinc blende, ZnS	*D*	2.3695	Baille
bromate, $Zn(BrO_3)_2 \cdot 6H_2O$	*D*	1.5452	Ortloff

INDEX OF REFRACTION OF UNIAXIAL CRYSTALS

The following table gives the index of refraction with reference to air for uniaxial crystals including minerals. More complete data for certain substances of optical importance will be found in succeeding tables.

Substance.	Spectrum line or wave length.	Index of refraction.		Observer.
		Ordinary.	Extraordinary.	
Alunite, $K_2O \cdot 3Al_2O_3 \cdot 4SO_3 \cdot 6H_2O$	*D*	1.572	1.592	
Ammonium arseniate, $NH_4H_2AsO_4$	*D*	1.5766	1.5217	Topsoe, Christiansen
monophosphate, $NH_4H_2PO_4$	*D*	1.5246	1.4792	Topsoe, Christiansen
uranyl acetate	*D*	1.4808	1.4933	Schrauf
Ammonium and cadmium chloride, $2NH_4Cl \cdot CdCl_2$	*D*	1.6038	1.6042	Schrauf
Ammonium and copper chloride, $2NH_4Cl \cdot CuCl_2 \cdot 2H_2O$	*D*	1.744	1.724	DeSenarmont
Anatase, TiO_2	*D*	2.53536	2.49585	Schrauf
Apatite, $Ca_5P_3O_{12}(ClF)$	*D*	1.6391	1.6355	Zymanyi
Apophyllite, $K_2O \cdot 8CaO \cdot 6SiO_2 \cdot 16H_2O$	*D*	1.535	1.537	
Argyrithrose, Ag_3SbS_3	*D*	3.084	2.881	Fizeau
Barysilite, $CPbO \cdot 2SiO_2$	*D*	2.070	2.050	
Benitoite, $BaO \cdot TiO_2 \cdot 3SiO_2$	*D*	1.757	1.804	
Benzil, $(C_6H_5CO)_2$	*D*	1.6588	1.6784	
Beryl, $3BeO \cdot Al_2O_3 \cdot 6SiO_2$	*D*	1.581	1.575	
Brucite, $MgO \cdot H_2O$	*D*	1.559	1.580	
Cacoxenite, $2Fe_2O_3 \cdot P_2O_5 \cdot 12H_2O$	*D*	1.582	1.645	
Cadmium potassium chloride, $2KCl \cdot CdCl_2$	*D*	1.5906	1.5907	Schrauf
Caesium thallium chloride, $Cs_3Tl_2Cl_9$	*D*	1.784	1.774	Pratt
Calcite, $CaO \cdot CO_2$	*D*	1.658	1.486	

INDEX OF REFRACTION OF UNIAXIAL CRYSTALS (Continued)

Substance.	Spectrum line or wave length.	Index of refraction.		Observer.
		Ordinary.	Extraordinary.	
Calcium chloride, $CaCl_2 \cdot 6H_2O$	yellow	1.417	1.393	Groth
Calcium copper acetate, $Ca(C_2H_3O_2)_2 \cdot Cu(C_2H_3O_2)_2$	*D*	1.436	1.478	Kohlrausch
Calcium hyposulfate, $CaS_2O_6 \cdot 4H_2O$	*D*	1.5496	.....	Topsoe, Christiansen
Calcium strontium propionate, $SrCa_2(C_3H_5O_2)_6$	*D*	1.4871	1.4956	Fritz, Sassoni
Calomel, HgCl	*D*	1.97325	2.6559	Dufet
Cancrinite, $4Na_2O \cdot CaO \cdot 4Al_2O_3 \cdot 2CO_2 \cdot 9SiO_2 \cdot 3H_2O$	*D*	1.524	1.496	
Cassiterite, SnO_2	*D*	1.997	2.093	
Chabazite, $(Ca, Na_2)O \cdot Al_2O_3 \cdot 4SiO_2 \cdot 6H_2O$	*D*	1.480	1.482	
Chiolite, $2NaF \cdot AlF_3$	*D*	1.349	1.342	
Chrysocolla, $CuO \cdot SiO_2 \cdot 2H_2O$	*D*	1.460	1.570	
Cinnabarite, HgS	*D*	2.854	3.201	
Connellite, $20CuO \cdot SO_3 \cdot 2CuCl_2 \cdot 20H_2O$	*D*	1.724	1.746	
Coquimbite, $Fe_2O_3 \cdot 3SO_3 \cdot 9H_2O$	*D*	1.550	1.556	
Corundum, Al_2O_3, sapphire, ruby	*D*	1.769	1.760	Osann
Derbylite, $6FeO \cdot Sb_2O_3 \cdot 5TiO_2$	*Li*	2.450	2.510	
Dioptasite, $CuO \cdot SiO_2 \cdot H_2O$	*D*	1.654	1.707	
Dolomite, $CaO \cdot MgO \cdot 2CO_2$	*D*	1.682	1.503	
Douglasite, $2KCl \cdot FeCl_2 \cdot 2H_2O$	*D*	1.488	1.500	
Emerald, *see* beryl.				
Eudialite, $6Na_2O \cdot 6(Ca, Fe)O \cdot 20(Si, Zr)O_2 \cdot NaCl$	*D*	1.606	1.611	
Ganomalite, $6PbO \cdot 4(Ca, Mn)O \cdot 6SiO_2 \cdot H_2O$	*D*	1.910	1.945	
Gehlenite, $2CaO \cdot Al_2O_3 \cdot SiO_2$	*D*	.669	1.658	
Geikielite, $(Mg, Fe)O \cdot TiO_2$	*D*	2.310	1.950	

INDEX OF REFRACTION OF UNIAXIAL CRYSTALS (Continued)

Substance.	Spectrum line or wave length.	Index of refraction.		Observer.
		Ordinary.	Extraordinary.	
Glucinum oxide, GlO	*D*	1.719	1.733	Mallard
sulfate, $GlSO_4 \cdot 4H_2O$	*D*	1.4714	1.4322	Wulff
	D	1.4720	1.4395	Topsoe, Christiansen
Hanksite, $11Na_2O \cdot 9SO_3 \cdot 2CO_2 \cdot KCl$	*D*	1.481	1.461	
Hematite, Fe_2O_3	*Li*	3.220	2.940	
Hydronephelite, $2Na_2O \cdot 3Al_2O_3 \cdot 6SiO_2 \cdot 7H_2O$	*D*	1.490	1.502	
Hydrotalcite, $6MgO \cdot Al_2O_3 \cdot CO_2 \cdot 15H_2O$	*D*	1.512	1.498	
Ice	*A*	1.3049	1.3062	Pulfrich
	D	1.3091	1.3104	Pulfrich
	F	1.3133	1.3147	Pulfrich
Iodyrite, AgI	*D*	2.210	2.220	
Ivory	*D*	1.539	1.541	Kohlrausch
Jarosite, $K_2O \cdot 3Fe_2O_3 \cdot 4SO_3 \cdot 6H_2O$	*D*	1.820	1.715	
Kaliophilite, $K_2O \cdot Al_2O_3 \cdot 2SiO_2$	*D*	1.537	1.533	
Lanthanum sulfate, $LaSO_4 \cdot 4H_2O$(?)	red	1.564	1.569	Des Cloizeaux
Laubanite, $2CaO \cdot Al_2O_3 \cdot 5SiO_2 \cdot 6H_2O$	*D*	1.475	1.486	
Magnesite, $MgO \cdot CO_2$	*D*	1.700	1.509	
Magnesium chlorostannate, $MgCl_2 \cdot SnCl_4 \cdot 6H_2O$	*D*	1.5885	1.597	Topsoe, Christiansen
fluosilicate, $MgF_2 \cdot SiF_4 \cdot 6H_2O$	*D*	1.3439	1.3602	Topsoe, Christiansen
platinocyanide, $Mg(CN)_2 \cdot Pt(CN)_2 \cdot 7H_2O$	*D*	1.5532		Grailich

INDEX OF REFRACTION OF UNIAXIAL CRYSTALS (Continued)

Substance.	Spectrum line or wave length.	Index of refraction.		Observer.
		Ordinary.	Extraordinary.	
Marialite, $3NaO_2 \cdot 3Al_2O_3 \cdot 18SiO_2 \cdot 2NaCl$	*D*	1.539	1.537	
Massicotite, PbO	*Li*	2.665	2.535	
Matlockite, $PbO \cdot PbCl_2$	*D*	2.150	1.040	
Meionite, $4CaO \cdot 3Al_2O_3 \cdot 6SiO_2$	*D*	1.597	1.560	
Melilite, Na_2O, CaO, Al_2O_3, SiO_2, etc.	*D*	1.634	1.629	
Mellite, $Al_2O_3 \cdot C_{12}O_9 \cdot 18H_2O$	*D*	1.539	1.511	
Milarite, $K_2O \cdot 4CaO \cdot 2Al_2O_3 \cdot 24SiO_2 \cdot H_2O$	*D*	1.532	1.529	
Mimetite, $9PbO \cdot 3As_2O_5 \cdot PbCl_2$	*D*	2.135	2.118	
Moissanite, CSi	*D*	2.654	2.697	
Nephelite, $Na_2O \cdot Al_2O_3 \cdot 2SiO_2$	*D*	1.542	1.538	
Nickel fluosilicate, $NiF_2 \cdot SiF_4 \cdot 6H_2O$	*D*	1.3910	1.4066	
selenate, $NiSeO_4 \cdot 6H_2O$	*D*	1.5393	1.5125	Topsoe, Christiansen
sulfate, $NiSO_4 \cdot 6H_2O$	*D*	1.5109	1.4873	Topsoe, Christiansen
Octahedrite, TiO_2	*D*	2.554	2.493	
Parisite, $2CeOF \cdot CaO \cdot 3CO_2$	*D*	1.676	1.757	
Penfieldite, $PbO \cdot 2PbCl_2$	*D*	2.130	2.210	
Penninnite, $5(Mg, Fe)O \cdot Al_2O_3 \cdot 3SiO_2 \cdot 4H_2O$	*D*	1.576	1.579	
Phenacite, $2BeO \cdot SiO_2$	*D*	1.654	1.670	
Phosgenite, $PbO \cdot PbCl_2 \cdot CO_2$	*D*	2.114	2.140	
Potassium arsenate, monobasic, KH_2AsO_4	*D*	1.5674	1.5179	Topsoe, Christiansen

INDEX OF REFRACTION OF UNIAXIAL CRYSTALS (Continued)

Substance.	Spectrum line or wave length.	Index of refraction.		Observer.
		Ordinary.	Extraordinary.	
copper chloride, $2KCl \cdot CuCl_2 \cdot 2H_2O$	*D*	1.6365	1.6148	Grailich
copper cyanide, $2KCN \cdot Cu(CN)_2$	*D*	1.5215		Grailich
hyposulfate, $K_2S_2O_6$	*D*	1.4550	1.5153	Topsoe, Christiansen
lithium sulfate, $LiKSO_4$	*D*	1.4715	1.4721	Wulff
phosphate, acid, KH_2PO_4	*D*	1.5095	1.4684	Topsoe, Christiansen
Powellite, $CaO \cdot MoO_3$	*D*	1.967	1.978	
Proustite, $3Ag_2S, As_2S_3$	*Li*	2.979	2.711	
Pyragyrite, $3Ag_2S \cdot Sb_2S_3$	*Li*	3.084	2.881	
Pyrochroite, $MnO \cdot H_2O$	*D*	1.723	1.681	
Pyromorphite, $9PbO \cdot 3P_2O_5 \cdot PbCl_2$	*D*	2.050	2.042	
Quartz, SiO_2	*D*	1.54424	1.55335	Mean
Rhodochrosite, $MnO \cdot CO_2$	*D*	1.818	1.505	
Rubidium hyposulfate, $Rb_2S_2O_6$	*D*	1.4574	1.5078	Topsoe, Christiansen
Ruby, *see* corundum.				
Rutile, TiO_2	*D*	2.661	2.903	
Sapphire, *see* corundum.				
Scheelite, $CaO \cdot WO_3$	*D*	1.918	1.934	
Sellaite, MgF_2	*D*	1.378	1.390	
Siderite, $FeO \cdot CO_2$	*D*	1.875	1.635	

INDEX OF REFRACTION OF UNIAXIAL CRYSTALS (Continued)

Substance.	Spectrum line or wave length.	Index of refraction.		Observer.
		Ordinary.	Extraordinary.	
Silicon carbide, carborundum	*D*	2.786	2.832	Becke
Silver phosphate, Ag_2HPO_4	*D*	1.8036	1.7983	Dufet
Smithsonite, $ZnO \cdot CO_2$	*D*	1.818	1.618	
Sodium arsenate, $Na_3AsO_4 \cdot 12H_2O$	*D*	1.4567	1.4662	Dufet
nitrate, $NaNO_3$	*D*	1.5874	1.3361	Schrauf
phosphate, $Na_3PO_4 \cdot 12H_2O$	*D*	1.4458	1.4524	Dufet
vanadate, $Na_3VO_4 \cdot 12H_2O$	*D*	1.5095	1.5232	Baker
vanadate, $Na_3VO_4 \cdot 10H_2O$	*D*	1.5398	1.5475	Baker
Stolzite, $PbO \cdot WO_3$	*D*	2.269	2.182	
Strychnine sulfate	*D*	1.6137	1.5988	Martin
Tapiolite, $FeO \cdot (TaCb)_2O_5$	*Li*	2.270	2.420	
Thaumasite, $3CaO \cdot CO_2 \cdot SiO_2 \cdot 15H_2O$	*D*	1.507	1.468	
Torbernite, $CUO \cdot 2UO_3 \cdot P_2O_5 \cdot 8H_2O$	*D*	1.592	1.582	
Tourmaline, Na_2O, FeO, Al_2O_3, B_2O_3, SiO_2, etc.	*D*	1.669	1.638	
Vanadinite, $9PbO \cdot 3V_2O_5 \cdot PbCl_2$	*D*	2.354	2.299	
Vesuvianite, $2(Ca, Mn, Fe)O \cdot (Al, Fe)(OH, F)O \cdot 2SiO_2$	*D*	1.716	1.718	
Wernerite	*D*	1.578	1.551	
Willemite, $2ZnO \cdot SiO_2$	*D*	1.694	1.723	
Wulfenite, $PbO \cdot MoO_3$	*Li*	2.402	2.304	
Xanotime, $Y_2O_3 \cdot P_2O_5$	*D*	1.721	1.816	
Zincite, ZnO	*D*	2.008	2.029	
Zircon, $ZrO_2 \cdot SiO_2$	*D*	1.923	1.968	

INDEX OF REFRACTION OF BIAXIAL CRYSTALS

The following table gives the indices of refraction and the angle between the optic axes for biaxial crystals. The index is relative to air and the wave length that of the D (Na) line except where noted.

Substance.	Index of refraction.			Angle of the optic axes.		Observer.
	n	n	n			
Actinolite, $CaO \cdot 3(Mg, Fe)O \cdot 4SiO_2$	1.611	1.627	1.636	80°	0′	1
Aegirine, $Na_2Fe_2Si_4O_{12}$	1.763	1.799	1.812	62	13	2
Albite, $Na_2O \cdot Al_2O_3 \cdot 6Si_3O_2$	1.529	1.533	1.539	—	—	3
Aluminite, $Al_2O_3 \cdot SO_3 \cdot 9H_2O$	1.459	1.464	1.470	—	—	—
Alunogenite, $Al_2O_3 \cdot 3SO_3 \cdot 16H_2O$	1.474	1.476	1.483	—	—	—
Amblygonite, $Al_2O_3 \cdot P_2O_5 \cdot 2LiF$	1.578	1.593	1.597	50		1
Ammonium antimonyl tartrate, $2(NH_4 \cdot SbO \cdot C_4H_4O_6) \cdot H_2O$	(C line)	1.6229	.....	68	8	4
carbonate, monobasic, $(NH_4)HCO_3$	1.4227	1.5358	1.5545	—	—	5
cobalt selenate, $(NH_4)_2Co(SeO_4)_2 \cdot 6H_2O$	1.524	1.531	1.540	82	1	4
cobalt sulfate, $(NH_4)_2 \cdot Co \cdot (SO_4)_2 \cdot 6H_2O$	1.490	1.496	1.5024	—	—	6
copper selenate, $(NH_4)_2SeO_4 \cdot CuSeO_4 \cdot 6H_2O$	1.5213	1.5355	1.5395	55	24	4
copper sulfate, $(NH_4)_2SO_4 \cdot CuSO_4 \cdot 6H_2O$	(yellow)	1.497	.....	71	21	7
iron selenate, $(NH_4)_2Fe(SeO_4)_2 \cdot 6H_2O$	1.5201	1.5260	1.5356	76	48	4
iron sulfate, $(NH_4)_2Fe(SO_4)_2 \cdot 6H_2O$	(yellow)	1.490	.....	76	52	7
lithium racemate, $(NH_4)Li(C_4H_4O_6) \cdot H_2O$	(red)	1.5287	.....	81	42	8
lithium sulfate, $(NH_4)LiSO_4$	(red)	1.437	.....	36	32	8
lithium tartrate, $(NH_4)Li(C_4H_4O_6) \cdot H_2O$	(red)	(red)	1.5673	87	6	8
magnesium selenate, $(NH_4)_2SeO_4 \cdot MgSeO_4 \cdot 6H_2O$	1.5056	1.5075	1.5150	53	44	4
magnesium sulfate, $(NH_4)_2 \cdot Mg(SO_4)_2 \cdot 6H_2O$	1.4717	1.4728	1.4791	50	40	4
malate	(red)	1.503	.....	47	34	8

INDEX OF REFRACTION OF BIAXIAL CRYSTALS (Continued)

Substance.	Index of refraction.			Angle of the optic axes.		Observer.
	n	n	n			
manganese sulfate, $(NH_4)_2 \cdot Mn(SO_4)_2 \cdot 6H_2O$	(yellow)	1.484	.....	69	9	6
nickel selenate, $(NH_4)_2 \cdot Ni(SeO_4)_2 \cdot 6H_2O$	1.5291	1.5372	1.5466	86	14	4
nickel sulfate, $(NH_4)_2 \cdot Ni(SO_4)_2 \cdot 6H_2O$	yellow 1.489	1.498	1.508	86	26	7
oxalate, $(NH_4)_2C_2O_4 \cdot H_2O$	1.4381	1.5475	1.5950	63	58	10
racemate, $(NH_4)_2C_4H_4O_6 \cdot 2H_2O$	(red)	1.564	.....	60	54	8
sodium racemate, $(NH_4)Na(C_4H_4O_6) \cdot H_2O$	(red)	1.473	.....	44	20	8
sodium tartrate, $(NH_4)Na(C_4H_4O_6) \cdot 4H_2O$	1.4950	1.4980	1.4990	96	30	8
sulfate, $(NH_4)_2SO_4$	1.5208	1.5232	1.5332	52	58	11
tartrate, acid, $(NH_4)H(C_4H_4O_6)$	1.5188	1.5614	1.5910	79	54	4
tartrate, neutral, $(NH_4)_2C_4H_4O_6$	(yellow)	1.581	.....	30	36	12
zinc selenate, $(NH_4)_2Zn(SeO_4)_2 \cdot 6 \cdot H_2O$	1.5233	1.5292	1.5372	81	22	4
zinc sulfate, $(NH_4)_2Zn(SO_4)_2 \cdot 6H_2O$	1.4890	1.4934	1.4996	79	43	13
Andalusite, $Al_2O_3 \cdot SiO_2$	red 1.632	1.638	1.643	84	30	12
Andesine, $(CaO, Na_2O)Al_2O_3 \cdot 4SiO_2$	1.549	1.553	1.556	88		1
Anglesite, PbO, SO_3	1.8771	1.8822	1.8936	75	24	14
Anhydrite, CaO, SO_3	1.5693	1.5751	1.6130	43	41	15
Anorthite, $CaO \cdot Al_2O_3 \cdot 2SiO_2$	1.574	1.581	1.586	77		1
Anorthoclase, $(Na, K)_2O \cdot Al_2O_3 6SiO_2$	1.523	1.529	1.531			
Anthophyllite, $MgO \cdot SiO_2$	1.633	1.642	1.657	83	54	1
Antigorite, $(MgO)_3(SiO_2)_2 \cdot 3H_2O$, serpentine	1.560	1.570	1.571	....	....	1
Antipyrin, $C_{11}H_{12}NO_2$	1.5697	1.6935	1.7324	54	20	16

INDEX OF REFRACTION OF BIAXIAL CRYSTALS (Continued)

Substance.	Index of refraction.			Angle of the optic axes.		Observer.
	n	n	n			
Aragonite, $CaO \cdot CO_2$	1.52999	1.68116	1.68567	18	117	17, 18
Arcanite, $K_2O \cdot SO_3$	1.494	1.495	1.497			
Asparagine, $C_4H_8O_3N_2$	1.5476	1.5800	1.6190	86	28	19
Atacamite, $3CuO \cdot CuCl_2 \cdot 3H_2O$	1.831	1.861	1.880			
Augelite, $2Al_2O_3P_2O_5 \cdot 3H_2O$	1.5736	1.5759	1.5877	50	49	20
Augite, $Ca(Fe, Mg)Si_2O_6 \cdot MgAl_2SiO_6$	1.688–1.712	1.701–1.717	1.713–1.733	60		3, 1
Autunite, $CaO \cdot 2UO_3 \cdot P_2O_5 \cdot 8H_2O$	1.553	1.575	1.577	30		1
Axinite, $6(Ca, Mn)O \cdot 2Al_2O_3 \cdot B_2O_3 \cdot 8SiO_2 \cdot H_2O$	1.678	1.685	1.688	72		12
Azurite, $3CuO \cdot 2CO_2 \cdot H_2O$	1.730	1.758	1.838			
Baddeleyite, ZrO_2	2.130	2.190	2.200			
Barite, $BaO \cdot SO_3$	1.63609	1.63726	1.64814	36	48	17, 15
Barium cadmium bromide, $BaBr_2 \cdot CdBr_2 \cdot 4H_2O$	(yellow)	1.702	.....	....	....	7
cadmium chloride, $BaCl_2 \cdot CdCl_2 \cdot 4H_2O$	.....	1.651	.....	61	1	7
chlorate, $Ba(ClO_3)_2 \cdot H_2O$	1.5622	1.577	1.635	55	30	21
chloride, $BaCl_2 \cdot 2H_2O$	yellow 1.635	1.644	1.664	84	20	12
formate, $Ba(HCO_2)_2$	1.5729	1.5970	1.6361	76	42	12
hyposulfate, $BaS_2O_6 \cdot 2H_2O$	1.5860	1.5951	1.6072	84	33	10
platinocyanide, $Ba(CN)_2 \cdot Pt(CN) \cdot 4H_2O$	(red)	1.662	.....	20	51	7
propionate, $Ba(C_3H_5O_2)_2 \cdot H_2O$	.....	1.5175	.....	81	36	22
Beccarite, $ZrO_2 \cdot SiO_2$	1.9272	1.9277	1.9820	....	....	23
Bertrandite, $Be_4Si_2O_8$	1.588	1.593	1.611	74	51	1, 24
Beryllonite, $Na_2O \cdot 2BeO \cdot P_2O_5$	1.5520	1.5579	1.5608	67	56	25

Substance.	Index of refraction.			Angle of the optic axes.		Observer.
	n	n	n			
Biotite, $K_2O \cdot 4(Mg, Fe)O \cdot 2Al_2O_3 \cdot 6SiO_2 \cdot H_2O$	1.541	1.574	1.574			
Boracite, $4(MgB_4O_7) \cdot MgCl_2 \cdot 2MgO$	yellow 1.662	1.667	1.673	83	33	26
Borax, $Na_2B_4O_7 \cdot 10H_2O$	1.4467	1.4694	1.4724	39	21	27
Bloedite, $Na_2O \cdot MgO \cdot 2SO_3 \cdot 4H_2O$	1.486	1.488	1.489			
Brookite, TiO_2	2.5832	2.5856	2.7414	17	7	2
Cadmium caesium sulfate, $CdSO_4 \cdot Cs_2SO_4 \cdot 6H_2O$	1.4975	1.5000	1.5062	67	53	28
magnesium chloride, $(CdCl_2)_2 \cdot MgCl_2 \cdot 12H_2O$	(yellow)	1.5331	1.5769	....	....	9
rubidium sulfate, $CdSO_4 \cdot Rb_2SO_4 \cdot 6H_2O$	1.4798	1.4848	1.4948	72	26	28
sulfate, $3CdSO_4 \cdot 8H_2O$	(yellow)	1.565	.....	88	9	12
Caesium cobalt sulfate, $Cs_2SO_4 \cdot CoSO_4 \cdot 6H_2O$	1.5057	1.5085	1.5132	81	34	28
copper sulfate, $Cs_2SO_4 \cdot CuSO_4 \cdot 6H_2O$	1.5048	1.5061	1.5153	43	24	28
iron sulfate, $Cs_2SO_4 \cdot FeSO_4 \cdot 6H_2O$	1.5003	1.5035	1.5094	74	51	28
magnesium sulfate, $Cs_2SO_4 \cdot MgSO_4 \cdot 6H_2O$	1.4857	1.4858	1.4916	16	25	28
manganese sulfate, $Cs_2SO_4 \cdot MnSO_4 \cdot 6H_2O$	1.4946	1.4966	1.5025	50	57	28
nickel sulfate, $Cs_2SO_4 \cdot NiSO_4 \cdot 6H_2O$	1.5087	1.5129	1.5162	87	21	28
selenate, Cs_2SeO_4	1.5989	1.5999	1.6003	71	49	28
sulfate, Cs_2SO_4	1.5598	1.5644	1.5662	65	20	28
zinc sulfate, $Cs_2SO_4 \cdot ZnSO_4 \cdot 6H_2O$	1.5022	1.5048	1.5093	74	11	28
Calamine, $2ZnO \cdot SiO_2 \cdot H_2O$	1.614	1.617	1.636	46	10	5
Calcium borate, CaB_2O_7	1.540	1.656	1.682	....	....	26
formate, $Ca(HCO_2)_2$	1.5101	1.5135	1.5775	....	....	19
malate, $Ca(C_4H_5O_5)_2 \cdot 6H_2O$	1.4933	1.5073	1.5449	....	....	19
Caledonite, $2(Pb, Cu)O \cdot SO_3 \cdot H_2O$	1.818	1.866	1.909			

INDEX OF REFRACTION OF BIAXIAL CRYSTALS (Continued)

Substance.	Index of refraction.			Angle of the optic axes.	Observer.
	n	n	n		
Carnallite, $KCl \cdot MgCl_2 \cdot 6H_2O$	1.466	1.475	1.494		
Celestite, $SrO \cdot SO_3$	1.622	1.624	1.631	51 12	29
Cerium hyposulfate, $CeS_2O_6 \cdot 5H_2O$	.....	1.507	.....	88 52	8
Cerussite, $PbO \cdot CO_2$	1.8037	2.0763	2.0780	....	19
Chalcanthite, $CuO \cdot SO_3 \cdot 5H_2O$	1.516	1.539	1.546		
Chloral hydrate, $CCl_3 \cdot CH(OH)_2$	1.5383	1.5995	1.6017	20 48	27
Chondrodite, $4MgO \cdot 2SiO_2 \cdot Mg(F, OH)_2$	1.609	1.619	1.639	80	12
Chrysoberyl, $BeO \cdot Al_2O_3$	1.747	1.748	1.757		
Citric acid, $C_6H_8O_7 \cdot H_2O$	1.4932	1.4977	1.5089	....	19
Claudetite, As_2O_3	1.871	1.920	2.010		
Cobalt acetate, $Co(C_2H_3O_2)_2 \cdot 4H_2O$	(yellow)	1.542	.....	30 43	7
rubidium sulfate, $CoSO_4 \cdot Rb_2SO_4 \cdot 6H_2O$	1.4859	1.4916	1.5014	75 11	28
selenate, $CoSeO_4 \cdot 6H_2O$	.....	1.5225	1.5227	7 13	4
Copper formate, $Cu(HCO_2)_2 \cdot 4H_2O$	1.4133	1.5423	1.5571	....	27
strontium formate, $Cu(HCO_2)_2 \cdot 2(Sr(HCO_2)) \cdot 8H_2O$	1.4995	1.5199	1.5801	72 4	10
sulfate, $CuSO_4 \cdot 5H_2O$	1.5161	1.5394	1.5460	55 45	29
Codein, $C_{18}H_{21}NO_3 \cdot H_2O$	1.5390	1.5435	.....	....	9
Colemanite, $2CaO \cdot 3Be_2O_3 \cdot 5H_2O$	1.58626	1.59202	1.61398	55 20	15, 20
Copiapite, $2Fe_2O_3 \cdot 5SO_3 \cdot 18H_2O$	1.530	1.543	1.595		
Cordierite, $4(Mg, Fe)O \cdot 4Al_2O_3 \cdot 10SiO_2 \cdot H_2O$ (Ceylon)	1.5384	1.5401	1.5438	85 50	31, 32
	1.59172	1.59700	1.59919	....	17
Cotunnite, $PbCl_2$	2.200	2.217	2.260		

INDEX OF REFRACTION OF BIAXIAL CRYSTALS (Continued)

Substance.	Index of refraction.			Angle of the optic axes.		Observer.
	n	n	n			
Crocoite, $PbO \cdot CrO_3$	*Li* 2.310	2.370	2.660			
Cyanite, $Al_2O_3 \cdot SiO_2$	1.712	1.720	1.728			
Danburite, $CaO \cdot B_2O_3 \cdot 2SiO_2$	1.632	1.634	1.636			
Datolite, $2CaO \cdot 2SiO_2 \cdot B_2O_3 \cdot H_2O$	1.625	1.653	1.669			
Diasporite, $Al_2O_3 \cdot H_2O$	1.702	1.722	1.750			
Diopside, $CaO \cdot MgO \cdot 2SiO_2$	1.664	1.671	1.694			
Enstatite, $MgO \cdot SiO_2$	1.650	1.653	1.658			
Epidote, $4CaO \cdot 3(AlFe)_2O_3 \cdot 6SiO_2 \cdot H_2O$	1.729	1.754	1.768			
Epsomite, $MgO \cdot SO_3 \cdot 7H_2O$	1.433	1.455	1.461			
Erythrite, $3CoO \cdot As_2O_5 \cdot 8H_2O$	1.626	1.661	1.699			
Euclasite, $2BeO \cdot Al_2O_3 \cdot 2SiO_2 \cdot H_2O$	1.652	1.655	1.671			
Fayalite, $2FeO \cdot SiO_2$	1.824	1.864	1.874			
Ferrous sulfate, $FeSO_4 \cdot 7H_2O$	1.4713	1.4782	1.4856	85	27	11
Forsterite, $2MgO \cdot SiO_2$	1.635	1.651	1.670			
Gaylussite, $Na_2O \cdot CaO \cdot 2CO_2 \cdot 5H_2O$	1.444	1.516	1.523	33	46	
Gibbsite, $Al_2O_3 \cdot 3H_2O$	1.566	1.566	1.587			
Glauberite, $Na_2O \cdot CaO \cdot 2SO_3$	1.515	1.532	1.536			
Glaucophanite, $Na_2O \cdot 2FeO \cdot Al_2O_3 \cdot 6SiO_2$	1.621	1.638	1.638	43	58	
Glucinum selenate, $GlSeO_4 \cdot 4H_2O$	1.4664	1.5007	1.5027	26	48	4
Goethite, $Fe_2O_3 \cdot H_2O$	*Li* 2.210	2.350	2.350			
Goslarite, $ZnO \cdot SO_3 \cdot 7H_2O$	1.457	1.480	1.484			
Gypsum, $CaO \cdot SO_3 \cdot 2H_2O$	1.52046	1.52260	1.52962	58	5	27

INDEX OF REFRACTION OF BIAXIAL CRYSTALS (Continued)

Substance.	Index of refraction.			Angle of the optic axes.		Observer.
	n	n	n			
Hambergite, Be_2HBO_4	1.5595	1.5908	1.6311	87	7	33
Harmotomite, $(K_2, Ba)O \cdot Al_2O_3 \cdot 5SiO_2 \cdot 5H_2O$	1.503	1.505	1.508			
Herderite, $CaPO_4 \cdot BeFOH$	1.592	1.612	1.621	68	2	12, 34
Heulandite, $CaO \cdot Al_2O_3 \cdot 6SiO_2 \cdot 3H_2O$	1.498	1.499	1.505	....	....	1
Hopeite, $3ZnO \cdot P_2O_5 \cdot 4H_2O$	1.527	1.590	1.590	54	44	12
Hornblende, Na_2O, MgO, FeO, SiO_2, etc.	1.629	1.642	1.653	84		1
Huebnerite, $MnO \cdot WO_3$	2.170	2.220	2.320			
Hutchinsonite, $(Tl, Ag)_2S \cdot PbS \cdot 2As_2S_3$	3.078	3.176	3.188			
Hydrocarbostyril, C_9H_9ON	1.47917	1.70947	1.81020	60		35
Hydromagnesite, $4MgO \cdot 3CO_2 \cdot 4H_2O$	1.527	1.530	1.540			
Kainite, $MgO \cdot SO_3 \cdot KCl \cdot 3H_2O$	1.494	1.505	1.516			
Kieserite, $MgO \cdot SO_3 \cdot H_2O$	1.523	1.535	1.586			
Labradorite	1.559	1.563	1.568			
Lanarkite, $2PbO \cdot SO_3$	1.930	1.990	2.020			
Lanthanite, $La_2O_3 \cdot 3CO_2 \cdot 9H_2O$	1.520	1.587	1.613			
Laumontite, $CaO \cdot Al_2O_3 \cdot 4SiO_2 \cdot 4H_2O$	1.513	1.524	1.525			
Laurionite, $PbCl_2 \cdot PbO \cdot H_2O$	2.077	2.116	2.158			
Lazulite, $(Fe, Mg)O \cdot Al_2O_3 \cdot P_2O_5 \cdot H_2O$	1.603	1.632	1.639			
Lead acetate, $Pb(C_2H_3O_2)_2 \cdot 3H_2O$	.....	1.576	.....	83	55	12
carbonate, *see* cerussite.						
chloride, $PbCl_2$	2.19924	2.21723	2.25965	66	12	36
Leadhillite, $4PbO \cdot SO_3 \cdot 2CO_2 \cdot H_2O$	1.870	2.000	2.010			
Lepidocrocite, $Fe_2O_3 \cdot H_2O$	1.930	2.210	2.510			
Lepidolite, $Al_2O_3 \cdot 3SiO_2 \cdot 2(K, Li)F$	1.560	1.598	1.605			

INDEX OF REFRACTION OF BIAXIAL CRYSTALS (Continued)

Substance.	Index of refraction.			Angle of the optic axes.		Observer.
	n	n	n			
Limonite	2.170	2.290	2.310			
Lithargite, PbO	2.510	2.610	2.710			
Lithium carbonate, Li_2CO_3	1.428	1.567	1.572	....	....	26
hyposulfate, $Li_2S_2O_6 \cdot 2H_2O$	1.5487	1.5602	1.5788	78	16	4
rubidium tartrate, $LiRb(C_4H_4O_6) \cdot H_2O$	(red)	1.552	.....	57	10	8
sodium racemate, $LiNa(C_4H_4O_6) \cdot H_2O$	(red)	1.4904	.....	68	57	8
sulfate, $LiSO_4$	.....	1.465	.....	72	58	8
Magnesium acetate, $Mg(C_2H_3O_2)_2 \cdot H_2O$	.....	1.491	.....	56	34	7
borate, MgB_2O_6	1.6527	1.6537	1.6748	....	....	26
carbonate, $MgCO_3 \cdot 3H_2O$	1.495	1.501	1.526	53	5	34
chromate, $MgCrO_4 \cdot 7H_2O$	1.5211	1.5500	1.5680	75	28	4
rubidium sulfate, $MgSO_4 \cdot Rb_2SO_4 \cdot 6H_2O$	1.4672	1.4689	1.4779	48	46	28
selenate, $MgSeO_4 \cdot 6H_2O$	1.4856	1.4892	1.4911	28	12	4
sulfate, $MgSO_4 \cdot 7H_2O$	1.4328	1.4555	1.4610	51	25	37
Malachite, $2CuO \cdot CO_2 \cdot H_2O$	1.655	1.875	1.909			
Manganese borate, MnB_2O_5	1.617	1.738	1.776	55	47	26
rubidium sulfate, $MnSO_4 \cdot Rb_2SO_4 \cdot 6H_2O$	1.4764	1.4809	1.4910	67	38	13
Manganite, $Mn_2O_3 \cdot H_2O$	2.240	2.240	2.530			
Mascagnite, $(NH_4)_2O \cdot SO_3$	1.521	1.523	1.533			
Matlockite, $PbO \cdot PbCl_2$	2.040	2.150	2.150			
Melanterite, $FeO \cdot SO_3 \cdot 7H_2O$	1.471	1.478	1.486			
Mendipite, $2PbO \cdot PbCl_2$	2.240	2.270	2.310			
Microcline, $K_2O \cdot Al_2O_3 \cdot 6SiO_2$	1.522	1.526	1.530			

INDEX OF REFRACTION OF BIAXIAL CRYSTALS (Continued)

Substance.	Index of refraction.			Angle of the optic axes.		Observer.
	n	n	n			
Mirabilite, $Na_2O \cdot SO_3 \cdot 10H_2O$	1.394	1.396	1.398			
Monetite, $2CaO \cdot P_2O_5 \cdot H_2O$	1.515	1.518	1.525			
Monticellite, $CaO \cdot MgO \cdot SiO_2$	1.651	1.662	1.668			
Montroydite, HgO	2.370	2.500	2.650			
Muscovite, $K_2O \cdot 3Al_2O_3 \cdot 6SiO_2 \cdot 2H_2O$	1.561	1.590	1.594			
Natrolite, $Na_2O \cdot Al_2O_3 \cdot 3SiO_2 \cdot 2H_2O$	1.480	1.482	1.493			
Natron, $Na_2O \cdot CO_2 \cdot 10H_2O$	1.405	1.425	1.440			
Newberyite, $2MgO \cdot P_2O_5 7H_2O$	1.514	1.519	1.533			
Nickel rubidium sulfate, $NiSO_4 \cdot Rb_2SO_4 \cdot 6H_2O$	1.4895	1.4961	1.5052	82	..	28
sulfate, $NiSO_4 \cdot 7H_2O$	1.4669	1.4888	1.4921	41	56	4
Niter, $K_2O \cdot N_2O_5$	1.334	1.505	1.506			
Oligoclase	1.539	1.543	1.547			
Olivenite, $4CuO \cdot As_2O_5 \cdot H_2O$	1.772	1.810	1.863			
Olivine, Mg_2SiO_4	1.653	1.670	1.689	88	54	3
Orthoclase, $K_2O \cdot Al_2O_3 \cdot 6SiO_2$	1.518	1.524	1.526			
Pectolite, $Na_2O \cdot 4CaO \cdot 6SiO_2 \cdot H_2O$	1.595	1.606	1.634			
Petalite, $Li_2O \cdot Al_2O_3 \cdot 8SiO_2$	1.504	1.510	1.516	83	34	1, 12
Phlogopite, $K_2O \cdot 6MgO \cdot Al_2O_3 \cdot 6SiO_2 \cdot 2H_2O$	1.562	1.606	1.606			
Potassium bichromate, $K_2Cr_2O_7$	1.7202	1.7380	1.8197	51	53	27
chromate, K_2CrO_4	.....	1.7254	.....	51	40	4
cobalt selenate, $K_2SeO_4 \cdot CoSeO_4 \cdot 6H_2O$	1.5135	1.5195	1.5358	63	52	4
cobalt sulfate, $K_2SO_4 \cdot CoSO_4 \cdot 6H_2O$	1.4807	1.4865	1.5004	68	41	28
copper selenate, $K_2ScO_4 \cdot CuSeO_4 \cdot 6H_2O$	1.5096	1.5235	1.5385	88	12	4

INDEX OF REFRACTION OF BIAXIAL CRYSTALS (Continued)

Substance.	Index of refraction.			Angle of the optic axes.	Observer.
	n	n	n		
Potassium copper sulfate, $K_2SO_4 \cdot CuSO_4 \cdot 6H_2O$	1.4836	1.4864	1.5020	46 32	28
ferricyanide, $K_3Fe(CN)_6$	1.5660	1.5689	1.5831	....	19
ferrocyanide, $K_4Fe(CN)_6 \cdot 3H_2O$	.....	1.5772	.....	78 10	27
hypophosphate, $K_2H_2P_2O_6 \cdot 2H_2O$	1.4893	1.5314	1.5363	36 12	27
hypophosphate, $K_2H_2P_2O_6 \cdot 3H_2O$	1.4768	1.4843	1.4870	61 48	27
lithium ferrocyanide, $K_2Li_2Fe(CN)_6 \cdot 3H_2O$	1.5883	1.6007	1.6316	65 56.5	8
lithium tartrate, $LiK(C_4H_4O_6) \cdot H_2O$	(red)	1.5226	.....	75 58	8
magnesium selenate, $K_2SeO_4 \cdot MgSeO_4 \cdot 6H_2O$	1.4950	1.4970	1.5120	40 22	4
magnesium sulfate, $K_2SO_4 \cdot MgSO_4 \cdot 6H_2O$	1.4607	1.4629	1.4755	47 54	28
nickel selenate, $K_2SeO_4 \cdot NiSeO_4 \cdot 6H_2O$	1.5199	1.5248	1.5339	72 56	4
nickel sulfate, $K_2SO_4 \cdot NiSO_4 \cdot 6H_2O$	1.4836	1.4916	1.5051	75 16	28
nitrate, KNO_3	1.3346	1.5056	1.5064	....	19
osmium cyanide, $K_4Os(CN)_6 \cdot 3H_2O$	.....	1.6071	.....	47	27
platinum dibrom-nitrite, $K_2Br_2Pt(NO_2)_2 \cdot H_2O$	1.626	1.6684	1.757	72 21	27
ruthenium cyanide, $KRu(CN)_6 3H_2O$	.....	1.5837	.....	54 0	27
selenate, K_2SeO_4	1.5352	1.5390	1.5446	76 50	28
sulfate, K_2SO_4	1.4935	1.4947	1.4973	67 20	28
zinc selenate, $K_2SeO_4 \cdot ZnSeO_4 \cdot 6H_2O$	1.5115	1.5177	1.5327	66 8	4
zinc sulfate, $K_2SO_4 \cdot ZnSO_4 \cdot 6H_2O$	1.4775	1.4833	1.4969	68 14	28
Prehnite, $2CaO \cdot Al_2O_3 \cdot 3SiO_2 \cdot H_2O$	1.616	1.626	1.649	67	12
Pseudobrookite, $2Fe_2O_3 \cdot 3TiO_2$	*Li* 2.380	2.390	2.420		
Pyrophyllite, $Al_2O_3 \cdot 4SiO_2 \cdot H_2O$	1.552	1.588	1.600		

INDEX OF REFRACTION OF BIAXIAL CRYSTALS (Continued)

Substance.	Index of refraction.			Angle of the optic axes.		Observer.
	n	*n*	*n*			
Racemic acid, $C_4H_6O_6 \cdot H_2O$	(yellow)	1.526	.....	....	....	38
Raspite, $PbO \cdot WO_3$	2.270	2.270	2.300			
Realgar, AsS	*Li* 2.460	2.590	2.610			
Resorcin, $C_6H_6O_2$	.....	1.555	.....	46	14	38
Rubidium selenate, Rb_2SeO_4	1.5515	1.5537	1.5582	68	53	28
sulfate, Rb_2SO_4	1.5131	1.5133	1.5144	....	....	13
zinc sulfate, $Rb_2SO_4 \cdot ZnSO_4 \cdot 6H_2O$	1.4833	1.4882	1.4976	72	30	13
Sassolite, $B_2O_3 \cdot H_2O$	1.340	1.456	1.495			
Sillimanite, $Al_2O_3SiO_2$	1.659	1.661	1.680	26	—	1
Scolecite, $CaO \cdot Al_2O_3 \cdot SiO_2 \cdot 3H_2O$	1.512	1.519	1.519			
Scorodite, $Fe_2O_3 \cdot As_2O_5 \cdot 4H_2O$	1.765	1.774	1.797			
Sodium arsenate, $Na_2HAsO_4 \cdot 12H_2O$	1.4453	1.44955	1.4513	65	13	27
$Na_2HAsO_4 \cdot 7H_2O$	1.4622	1.4658	1.4782	57	7	27
$NaH_2AsO_4 \cdot 2H_2O$	1.4794	1.5021	1.5265	88	57	27
$NaH_2AsO_4 \cdot H_2O$	1.5382	1.5535	1.5607	67	57	27
bichromate, $Na_2Cr_2O_7 \cdot 2H_2O$	1.6610	1.6994	1.7510	83	42	27
ferrocyanide, $Na_4Fe(CN)_6 \cdot 12H_2O$	(yellow)	1.529	.....	81	25	12
hypophosphate, $Na_4P_2O_6 \cdot 10H_2O$	1.4777	1.4822	1.5036	48	50	27
$Na_3HP_2O_6 \cdot 9H_2O$	1.4653	1.4738	1.4804	82	0	27
$Na_2H_2P_2O_6 \cdot 6H_2O$	1.4855	1.4897	1.5041	57	20	27
hypophosphite, $Na_2HPO_3 \cdot 5H_2O$	.....	1.4434	.....	44	7	27
$NaH_2PO_3 \cdot 5H_2O$	1.4193	1.4309	1.4493	77	38	27

INDEX OF REFRACTION OF BIAXIAL CRYSTALS (Continued)

Substance.	Index of refraction.			Angle of the optic axes.		Observer.
	n	n	n			
hyposulfate, $Na_2S_2O_3 \cdot 2H_2O$	yellow 1.4820	1.4954	1.5185	75	14	5
molybdate, $Na_6Mo_7O_{24} \cdot 22H_2O$	(yellow)	1.627	.....	84	6	12
phosphate, $Na_2HPO_4 \cdot 12H_2O$	1.4321	1.4361	1.4373	56	43	27
$Na_2HPO_4 \cdot 7H_2O$	1.44115	1.4424	1.4526	38	50	27
$NaH_2PO_4 \cdot 2H_2O$	1.44005	1.4629	1.48145	82	35	27
$NaH_2PO_4 \cdot H_2O$	1.4557	1.4852	1.4873	29	22	27
pyrophosphate, $Na_4P_2O_7 \cdot 10H_2O$	1.4499	1.4525	1.4604	60	29	27
$Na_2H_2P_2O_7 \cdot 6H_2O$	1.4599	1.4645	1.4649	31	56	27
tartrate, acid, $NaH(C_4H_4O_6) \cdot H_2O$	(red)	1.5332	.....	51	31	10
Sodium thiosulfate (hypo), $Na_2S_2O_3 \cdot 5H_2O$	1.4886	1.5079	1.5360	80	40	27
ruthenium nitrate, $(RuNO)_2O_3 \cdot (N_2O_3)_2 \cdot 4NaNO_2 \cdot 4H_2O$	1.5888	1.5943	1.7162	25	14	27
Spodumenite, $Li_2O \cdot Al_2O_3 \cdot 4SiO_2$	1.660	1.666	1.676			
Staurolite, $2FeO \cdot 5Al_2O_3 \cdot 4SiO_2 \cdot H_2O$	1.736	1.741	1.746	88		1
Sterocite, $Na_2O \cdot (NH_4)_2O \cdot P_2O_5 \cdot 9H_2O$	1.439	1.441	1.469			
Stibiotantalite, $Sb_2O_3 \cdot Ta_2O_5$	2.374	2.404	2.457			
Stibnite, Sb_2S_3	3.194	4.303	4.460			
Stilbite, $(Ca, Na_2)O \cdot Al_2O_3 \cdot 6SiO_2 \cdot 5H_2O$	1.494	1.498	1.500			
Strengite, $Fe_2O_3 \cdot P_2O_5 \cdot 4H_2O$	1.710	1.710	1.745			
Strontianite, $SrO \cdot CO_2$	1.518	1.664	1.665	....	....	26
Strontium bichromate, $SrCr_2O_7 \cdot 3H_2O$	1.7146	1.7174	1.812	20	28	8
formate, $Sr(HCO_2)_2 \cdot 2H_2O$	1.4838	1.5210	1.5382	....	....	19

INDEX OF REFRACTION OF BIAXIAL CRYSTALS (Continued)

Substance.	Index of refraction.			Angle of the optic axes.	Observer.
	n	n	n		
Struvite, $(NH_4)_2O \cdot 2MgO \cdot P_2O_5 \cdot 12H_2O$	.....	1.502	.....	.....	12
Sugar, cane, $C_{12}H_{22}O_{11}$	1.537	1.565	1.570	47 48	39
Sulfur	1.95047	2.03832	2.24052	69 5	19, 12
Talc, $3MgO \cdot 4SiO_2 \cdot H_2O$	1.539	1.589	1.589	.....	3
Tantalite, $(Fe, Mn)O \cdot Ta_2O_5$	*Li* 2.260	2.320	2.430		
Tartaric acid, (d), $C_4H_6O_6$	1.495	1.535	1.604	78 40	40
Terlinguaite, Hg_2OCl	*Li* 2.350	2.640	2.670		
Thenardite, $Na_2O \cdot SO_3$	1.464	1.474	1.485		
Thermonatrite, $Na_2O \cdot CO_2 \cdot H_2O$	1.420	1.495	1.518		
Thomsenolite, $NaF \cdot CaF_2 \cdot AlF_3 \cdot H_2O$	1.407	1.414	1.415		
Thomsonite, $(Na_2Ca)O \cdot Al_2O_3 \cdot 2SiO_2 \cdot 3H_2O$	1.497	1.503	1.525	53 50	12
Titanite, $CaO \cdot TiO_2 \cdot SiO_2$	1.9133	1.9206	2.0536	23 9	41
	1.900	1.907	2.034		
Topaz, $2AlOF \cdot SiO_2$, colorless	1.6114	1.6141	1.6213	65	17
Topaz, yellow, Brazil	1.6306	1.6313	1.6379	50	17
Tremolite, $CaO \cdot 3MgO \cdot 4SiO_2$	1.609	1.623	1.635		
Tridymite, SiO_2	1.469	1.470	1.473		
Triphylite, $Li_2O \cdot 2(Fe, Mn)O \cdot P_2O_5$	1.688	1.688	1.692		
Trona, $3Na_2O \cdot CO_2 \cdot H_2O$	1.410	1.492	1.542		
Turgite, $2Fe_2O_3 \cdot H_2O$, etc.	*Li* 2.450	2.550	2.550		

Substance.	Index of refraction.			Angle of the optic axes.		Observer.
	n	n	n			
Turquois, $CuO \cdot 3Al_2O_3 2P_2O_5 \cdot 9H_2O$	1.610	1.620	1.650			
Uranite, *see* autunite.						
Valentenite, Sb_2O_3	2.180	2.350	2.350			
Variscite, $Al_2O_3 \cdot P_2O_5 \cdot 4H_2O$	1.551	1.558	1.582			
Vivianite, $3FeO \cdot P_2O_5 \cdot 8H_2O$	1.579	1.603	1.633	73	10	
Wagnerite, $3MgO \cdot P_2O_5 \cdot MgF_2$	1.569	1.570	1.582	37	49	1, 33
Wavellite, $3Al_2O_3 \cdot 2P_2O_5 \cdot 12(H_2O, 2HF)$	1.525	1.534	1.552	71	48	
Whewellite, $CaO \cdot C_2O_3 \cdot H_2O$	1.491	1.555	1.650			
Witherite, $BaO \cdot CO_2$	1.529	1.676	1.677	.....		26
Wolframite, $(Fe, Mn)O \cdot WO_3$	2.310	2.360	2.460			
Wollastonite, $CaO \cdot SiO_2$	1.6177	1.6307	1.6325	40		3
Zinc sulfate, $ZnSO_4 \cdot 7H_2O$	1.45683	1.48010	1.48445	46	14	27

References

1 La Croix, 1809
2 Wülfing, 1891
3 Zimanyi, 1894
4 Topsoe, Christiansen, 1874
5 Von Lang, 1862
6 Ehlers, 1897
7 Murmann, Rotter, 1859
8 Wyrouboff, 1882–1886
9 Grailich, 1858
10 Brio, 1867
11 Erofejeff, 1867
12 Des Cloizeaux, 1857–1882
13 Perrot, 1891
14 Arzruni, 1877
15 Mülheims, 1888
16 Liwets, 1885
17 Offret, 1890
18 Kirchoff, 1859
19 Schrauf, 1860
20 Prior, Spencer, 1897
21 Eakle, 1896
22 Friedländer, 1879
23 Grattarola, 1890
24 Bertrand, 1880–1888
25 Dana, 1889
26 Mallard, 1883
27 Dufet, 1878–1891
28 Tutton, 1894–1897
29 Pape, 1874
30 Bodewig, 1876
31 Pulfrich, 1888
32 Osann, 1888
33 Brögger, 1879–1890
34 Penfield, 1890–1894
35 Blackström, 1889
36 Stöber, 1895
37 Borel, 1895
38 Groth, 1868–1885
39 Becke, 1877
40 Kohlrausch, 1878
41 Bluss, 1887

INDEX OF REFRACTION FOR LIQUIDS

The following table gives the index of refraction with respect to air for various liquids. The index is for sodium light (=.589) except where noted. Values for oils, fats and waxes will be found in a general table of constants for such substances. See index.

Substance.	Temp. ° C.	Index.	Observer.
Acetal	20	1.382	1
Acetaldehyde	20	1.3316	2
Acetic acid	20	1.372	3
anhydride	20	1.390	2
Acetone	20	1.359	4
Acetyl-acetone	15.5	1.449	5
Acetyl chloride	20	1.38976	1
Acetylene dibromide	20	1.5428	6
tetrabromide	0	1.64788	7
Acrolein	20	1.39975	1
Alcohol. *See under* ethyl, methyl, etc.			
Allyl alcohol	20	1.41345	1
amine	21.8	1.41943	1
bromide	20	1.46545	1
chloride	20	1.41538	1
mustard oil	20	1.52660	8
sulfide	26.8	1.48770	9
Aluminum ethyl	6.5	1.480	10
methyl	12	1.432	10
Ammonia, liquid (d = .615)	16.5	1.325	10
Amyl acetate	20	(C) 1.402	2
Amyl alcohol, primary, normal	17.8	1.408	2
alcohol, iso-, primary	20	1.407	1
chloride	18.2	1.4097	11
iodide	14	1.4960	6
Aniline	20	1.586	1
Anethol	11.5	1.5624	12
Anisol	21.8	1.515	9
Antimony pentachloride	17.5	1.587	6
Benzene	20	1.501	1
Benzonitrile	25.5	1.526	1
Benzoyl chloride	20	1.55369	1
Benzyl alcohol	20	1.539	1
amine	19.5	1.54406	1
chloride	15.4	1.5415	11
Boron tribromide	6.3	1.536	13
trichloride	5.7	1.419	13
Bromine	20	1.654	14
Brom-aniline, meta	20.4	1.62604	1
benzene	20	1.560	1
ethylene, di-	0	1.556	7
ethylene, tri- (bromoform)	20	1.589	15
naphthalene	20	1.658	1
Butyl aldehyde, normal	20	1.38433	1
aldehyde, iso-	20	1.37302	1
alcohol, normal	20	1.39909	1
alcohol, iso-	19.6	1.396	1
nitrate	23.2	1.40130	1
Carbon dioxide, liquid	15	1.195	10
disulfide	18	1.629	1
tetrachloride	20	1.4607	17
Chloral	20	1.456	1
Chlorine, liquid	14	1.367	10

INDEX OF REFRACTION FOR LIQUIDS (Continued)

Substance.	Temp. °C.		Index.	Observer.
Chlorobenzene	15		1.526	11
Chloroform	20		1.446	18
Cyanogen, liquid	18		1.327	10
Decane	14.9		1.4108	2
Diethylamine	17.6		1.38730	1
Dimethylamine	17.		1.350	10
Dimethylaniline	8		1.56489	5
Ether, ethyl	22		1.351	16
Ethyl benzene	20		1.496	1
acetate	16.4		1.374	19
alcohol	20.		1.361	21
benzoate	20		1.5057	20
benzol	14.5		1.4994	2
bromide	8		1.4320	6
carbonate	20		1.38523	1
carbylamine	24		1.3659	6
formate	20	(C)	1.35800	2
iodide	20		1.51203	18
mercaptan	20		1.43055	9
nitrate	21.5	(F)	1.38484	1
oxalate	20		1.41043	1
sulfate	16.1	(C)	1.40210	22
sulfite	11		1.4198	23
thiocyanate	22.9		1.46533	9
Ethylene, liquid	−100		1.363	24
bromide	10.5		1.5446	6
chloride	17		1.4466	11
formate	20	(C)	1.35800	2
glycol	22.5		1.4306	6
Ethylidene bromide	0		1.52455	7
chloride	0		1.42881	7
Eugenol, normal	14.5		1.5439	12
iso-	18		1.5680	12
Formamide	22.7		1.445	1
Formic acid	20		1.371	26
Furfurol	20		1.526	1
Glycerine	20		1.474	27
Glycol	20	(C)	1.425	2
Hexane	20		1.3754	1
Hexylene	23.3		1.3945	1
Hydrazine	22.3		1.470	1
Hydrobromic acid	10		1.325	10
Hydrochloric acid	10		1.254	10
Hydrogen	−200		1.12	28
Hydrogen sulfide	18.5		1.384	10
Hydroiodic acid	16.5		1.466	10
Hydroxylamine	23.5		1.440	1
Iodobenzene	8		1.627	5
Iodomethane, di-	25		1.737	5
Isoprene	18		1.4041	6
Lactic acid	20		1.441	2
Menthol	22		1.460	29
Methyl acetate	14.8		1.3632	30
alcohol	20		1.329	2
amine	17.5		1.432	10
benzoate	20	(C)	1.51158	2
chloride	0		1.353	31
iodide, *see* iodomethane.				
Naphthalene	98.4		1.582	32
Naphthol, (α)	98.7		1.62067	32
Nicotine	18.8		1.529	1

INDEX OF REFRACTION FOR LIQUIDS (Continued)

Substance.	Temp. °C.	Index.	Observer.
Nitric oxide	−90	1.330	24
Nitrobenzene	20	1.553	1
Nitrogen	−190	1.205	24
Nitroglycerine	18.6	1.482	6
Nitrous oxide, N_2O	15	1.194	10
Oenanthylic aci	20	1.426	1
Oleic acid	17.8	1.460	12
Oxygen	−181	1.222	33
Paraffin	38.3	(C) 1.43295	12
Paraldehyde	20	1.405	1
Pentane	15.7	1.358	2
Phenol	20	1.550	2
Phenylhydrazine	20.3	1.608	1
Phosphorous trichloride	15.4	1.520	22
Piperidine	18.7	1.453	1
Propionic acid	0	1.395	34
Propyl alcohol, primary	18.1	1.386	25
alcohol, iso-	20	1.377	1
Pyridine	21	1.509	1
Salicylic acid	20	1.565	2
Silicon tetrabromide	23.5	1.563	35
tetrachloride	22.9	1.412	35
Sulfur	130	1.890	36
Sulfur dioxide	15	1.350	10
Sulfuric acid	15	1.420	37
Thiophene	18.5	1.530	1
Thymol	24.4	1.519	32
Toluene	20	1.495	1
Toluidine, ortho-	20	1.573	1
meta	20	1.571	1
para	20	1.553	1
Triphenylamine	16	1.353	10
Triphenylmethane	99	1.578	5
Water	20	1.33299	—
Xylene, ortho	21.6	1.505	1
meta	20	1.496	1
para	14.7	1.498	2

References

1 Brühl, 1886
2 Landolt
3 Eisenlohr, 1910
4 Hubbard, 1910–1911
5 Perkin, 1890–1900
6 Gladstone, 1870
7 Weegmann, 1888
8 Berliner
9 Nasini, Scala
10 Bleekrode, 1884
11 Jahn, Moller, 1894
12 Eykman, 1893–1895
13 Ghira, 1893–1894
14 Riviere, 1900
15 Jahn, 1891
16 Cheneveau, 1907
17 Haagen, 1867
18 Lorenz, 1880
19 Fery, 1906
20 Hoeck, Oudemans
21 Rudolphi, 1901
22 Nasini, Costa, 1891
23 Nasini, 1882
24 Liveing, Dewar, 1892–1893
25 Schütt, 1892
26 Homfray, 1905
27 Damien, 1881
28 Dewar, 1906
29 Masson, Reychler
30 Prytz
31 Chappuis, 1892
32 Nasini, Bernheimer, 1884–1885
33 Olzewski, Witkowski, 1891
34 Korten, 1890
35 Abati, 1898
36 Becquerel, 1877
37 Veley, Manley, 1901–1905

INDEX OF REFRACTION OF WATER

Alcohol and Carbon Bisulfide

For sodium light, $\lambda = .5893$

Temp. °C	Water, pure relative to air	Ethyl Alcohol 99.8 relative to air	Carbon Bisulfide relative to air
14	1.33348	.....	.....
15	1.33341	.....	1.62935
16	1.33333	1.36210	1.62858
18	1.33317	1.36129	1.62704
20	1.33299	1.36048	1.62546
22	1.33281	1.35967	1.62387
24	1.33262	1.35885	1.62226
26	1.33241	1.35803	1.62064
28	1.33219	1.35721	1.61902
30	1.33192	1.35639	1.61740
32	1.33164	1.35557	1.61577
34	1.33136	1.35474	1.61413
36	1.33107	1.35390	1.61247
38	1.33079	1.35306	1.61080
40	1.33051	1.35222	1.60914
42	1.33023	1.35138	1.60748
44	1.32992	1.35054	1.60582
46	1.32959	1.34969	.....
48	1.32927	1.34885	.....
50	1.32894	1.34800	.....
52	1.32860	1.34715	.....
54	1.32827	1.34629	.....
56	1.32792	1.34543	.....
58	1.32755	1.34456	.....
60	1.32718	1.34368	.....
62	1.32678	1.34279	.....
64	1.32636	1.34189	.....
66	1.32596	1.34096	.....
68	1.32555	1.34004	.....
70	1.32511	1.33912	.....
72	1.32466	1.33820	.....
74	1.32421	1.33728	.....
76	1.32376	1.33626	.....
78	1.32332	.....	.....
80	1.32287	.....	.....
82	1.32241	.....	.....
84	1.32195	.....	.....
86	1.32148	.....	.....
88	1.32100	.....	.....
90	1.32050	.....	.....
92	1.32000	.....	.....
94	1.31949	.....	.....
96	1.31897	.....	.....
98	1.31842	.....	.....
100	1.31783	.....	.....

ABSOLUTE INDEX FOR PURE WATER FOR SODIUM LIGHT

Temperature	Index	Temperature	Index
15° C.	1.33377	60° C.	1.32754
20	1.33335	65	1.32652
25	1.33287	70	1.32547
30	1.33228	75	1.32434
35	1.33157	80	1.32323
40	1.33087	85	1.32208
45	1.33011	90	1.32086
50	1.32930	95	1.31959
55	1.32846	100	1.31819

INDEX OF REFRACTION OF GLASS

RELATIVE TO AIR

Variety.	Wave length in microns.							
	.361	.434	.486	.589 (Na)	.656	.768	1.20	2.00
Zinc crown	1.539	1.528	1.523	1.517	1.514	1.511	1.505	1.49
Higher dispersion crown	1.546	1.533	1.527	1.520	1.517	1.514	1.507	1.49
Light flint	1.614	1.594	1.585	1.575	1.571	1.567	1.559	1.54
Heavy flint	1.705	1.675	1.664	1.650	1.644	1.638	1.628	1.61
Heaviest flint	...	1.945	1.919	1.890	1.879	1.867	1.848	1.83

INDEX OF REFRACTION OF ROCK SALT, SILVINE, CALCITE, FLUORITE AND QUARTZ

(Compiled from data of Martens, Paschen, and others.)

Wave length.	Rock salt.	Silvine, KCl.	Fluorite.	Calcspar, ordinary ray.	Calcspar, extraordinary ray.	Quartz, ordinary ray.	Quartz extraordinary ray.
0.185	1.893	1.827	.....	.....	.....	1.676	1.690
0.198	.....	.....	1.496	.....	1.578	1.651	1.664
0.340	.....	.....	.....	1.701	1.506	1.567	1.577
0.589	1.544	1.490	1.434	1.658	1.486	1.544	1.553
0.760	.....	.....	1.431	1.650	1.483	1.539	1.548
0.884	1.534	1.481	1.430				
1.179	1.530	1.478	1.428				
1.229	.....	.....	.....	1.639	1.479		
2.324	.....	.....	.....	.....	1.474	1.516	
2.357	1.526	1.475	1.421				
3.536	1.523	1.473	1.414				
5.893	1.516	1.469	1.387				
8.840	1.502	1.461	1.331				

INDEX OF REFRACTION OF GLASS

Index of refraction of optical glass made at the Bureau of Standards.
Composition refers to the raw material combined, not to the finished glass.

Composition	Ordinary Crown	Borosilicate Crown	Barium flint	Light Barium flint	Light flint	Dense barium flint	Medium flint	Dense flint
				(Composition percentage)				
SiO_2	67.0	64.2	53.7	48.0	53.9	37.0	45.6	39.0
Na_2O	12.0	9.4	1.7	2.0	1.0	....	3.4	3.0
K_2O	5.0	8.3	8.3	6.1	7.6	2.7	4.1	4.0
B_2O_3	3.5	11.0	2.7	4.0	....	5.0	....	....
BaO	10.6	6.1	14.3	29.5	....	47.0	....	....
ZnO	1.5	....	2.5	10.0	....	7.7	....	....
As_2O_3	0.4	0.4	....	1.4	0.3	....	....	....
CaO	....	1.0	....	....	2.0	....	3.0	4.0
PbO	....	....	16.7	....	35.2	....	44.0	49.0
Sb_2O_3	....	....	....	....	....	....	....	1.0
Wave length, Å				(Index of Refraction)				
Hg 4046.8	1.53189	1.53817	1.58851	1.59137	1.60507	1.63675	1.65788	1.69005
Hg 4047.1	1.53147	1.53775	1.58791	1.59084	1.60430	1.63619	1.65692	1.68894
H 4340.7	1.52818	1.53468	1.58327	1.58698	1.59860	1.63189	1.64973	1.68079
Hg 4358.6	1.52798	1.53450	1.58299	1.58674	1.59826	1.63163	1.64931	1.68030
H 4861.5	1.52326	1.53008	1.57646	1.58121	1.59029	1.62548	1.63941	1.66911
Hg 4916.4	1.52283	1.52967	1.57587	1.58071	1.58958	1.62492	1.63854	1.66814
Hg 5461.0	1.51929	1.52633	1.57105	1.57657	1.58380	1.62033	1.63143	1.66016
Hg 5769.6	1.51771	1.52484	1.56894	1.57473	1.58128	1.61829	1.62834	1.65671
Hg 5790.5	1.51760	1.52475	1.56881	1.57460	1.58112	1.61817	1.62815	1.65650

INDEX OF REFRACTION OF GLASS (Continued)

Index of refraction of optical glass made at the Bureau of Standards.
Composition refers to the raw material combined, not to the finished glass.

(Index of Refraction) Continued

Wave Length, Å	Ordinary Crown	Borosilicate Crown	Barium flint	Light Barium flint	Light flint	Dense barium flint	Medium flint	Dense flint
Na 5893.2	1.51714	1.52430	1.56819	1.57406	1.58038	1.61756	1.62725	1.65548
Hg 6234.6	1.51573	1.52297	1.56634	1.57242	1.57818	1.61576	1.62458	1.65250
H 6563.0	1.51458	1.52188	1.56482	1.57107	1.57638	1.61427	1.62241	1.65007
Li 6708.2	1.51412	1.52145	1.56423	1.57054	1.57567	1.61369	1.62157	1.64913
K 7682.0	1.51160	1.51908	1.56100	1.56762	1.57183	1.61047	1.61701	1.64405
Dispersion								
N_d	1.51714	1.52430	1.56819	1.57406	1.58038	1.61756	1.62725	1.65548
$n_f - n_c$	0.00868	0.00820	0.01164	0.01014	0.01391	0.01121	0.01700	0.01904
$\frac{n_d - 1}{n_f - n_c} = \gamma$	59.6	63.9	48.8	56.6	41.7	55.1	36.9	34.4
$n_d - n_f$	0.00612	0.00578	0.00827	0.00715	0.00991	0.00792	0.01216	0.01363
$n_f - n_{g'}$	0.00492	0.00460	0.00681	0.00577	0.00831	0.00641	0.01032	0.01168
$n_d - n_c$	0.00256	0.00242	0.00337	0.00299	0.00400	0.00329	0.00484	0.00541

OPTICAL CONSTANTS OF METALS

The following table gives the refractive index n, the absorption index k, the angle of principle incidence $\overline{\phi}$, the angle of principle azimuth $\overline{\psi}$ and the percent of light reflected R.

The reduction of amplitude of the wave of the wave length λ after traveling any distance d in the medium is given by the ratio $1 : e^{\frac{2\pi dk}{\lambda}}$. $\overline{\phi}$ is the angle of incidence for which the phase change between the two rectangular components vibrating in and normal to the plane of incidence is 90°. $\overline{\psi}$ is the azimuth at which circularly polarized light results. These quantities are connected by the following relations

$$k = tan\ 2\overline{\psi}(1 - cot^2\ \overline{\phi}), \qquad n = \frac{sin\ \overline{\phi}\ tan\ \overline{\phi}}{(1+k^2)^{\frac{1}{2}}}\left(1 + \tfrac{1}{2}\ cot^2\ \overline{\phi}\right)$$

Metal	λ	$\overline{\phi}$	$\overline{\psi}$	Computed				Authority
				n	k	nk	R	
	μ	° ′	° ′					
Aluminum	0.589	.....	.....	1.44	5.32		83.	Drude
Antimony	.589	.....	.....	3.04	4.94		70.	"
Bismuth (prism)	white	.....	.....	2.26	....	....	....	Kundt, 1889
Bronze	.527	.....	.....	1.18	....	....	....	Jamin
	.589	.....	.....	1.12	....	....	....	"
Cadmium	.589	.....	.....	1.13	5.01	....	85.	Drude
Chromium	.579	.....	.....	2.97	4.85	....	70.	Wartenburg, 1910
Cobalt	0.231	64 31	29 39	1.10	1·30	1.43	32.	Minor
	.275	70 22	29 59	1.41	1.52	2.14	46.	"
	.500	77 5	31 53	1.93	1.93	3.72	66.	"
	.650	79 0	31 25	2.35.	1.87	4.40	69.	Ingersoll
	1.00	81 45	29 6	3.63.	1.58	5.73	73.	"
	1.50	83 21	26 18	5.22.	1.29	6.73	75.	"
	2.25	83 48	26 5	5.65	1.27	7.18	76.	"
Columbium	.579	.....	.....	1.80	2.11	....	41.	Wartenburg, 1910
Copper	.231	65 57	26 14	1.39	1.05	1.45	29.	Minor
	.347	65 6	28 16	1.19	1.23	1.47	32.	"
	.500	70 44	33 46	1.10	2.13	2.34	56.	"
	.650	74 16	41 30	0.44	7.4	3.26	86.	Ingersoll
	.870	78 40	42 30	0.35	11.0	3.85	91.	"
	1.75	84 4	42 30	0.83	11.4	9.46	96.	"
	2.25	85 13	42 30	1.03	11.4	11.7	97.	"
	4.00	87 20	42 30	1.87	11.4	21.3	....	Först-Fréed
	5.50	88.00	41 50	3.16	9.0	28.4	....	" "
Gold	.257	.....	.....	0.92	1.14	.....	28.	Meier, 1903
Electrolytic	.441	.....	.....	1.18	1.85	.....	42.	"
	.589	.....	.....	0.47	2.83	.....	82.	"
	1.00	81 45	14 00	0.24	28.0	6.7	....	Först-Fréed
	2.00	85 30	43 56	0.47	26.7	12.5	....	" "
	3.00	87 05	43 50	0.80	24.5	19.6	....	" "
	5.00	88 15	43 25	1.81	18.1	33.	....	" "
Iodine	.589	.....	.....	3.34	0.57	.....	30.	Meier, 1903
Iridium	.579	.....	.....	2.13	4.87	.....	75.	Wartenburg, 1916
	1.00	82 10	29 15	3.85	1.60	6.2	....	Först-Fréed
	2.00	83 10	29 40	4.30	1.66	7.1	....	" "
	3.00	81 40	30 40	3.33	1.79	6.0	....	" "
	5.00	79 00	32 20	2.27	2.03	4.6	....	" "
Iron	.257	.....	.....	1.01	0.88	.....	16.	Meier, 1903
	.441	.....	.....	1.28	1.37	.....	28.	"
	.589	.....	.....	1.51	1.63	.....	33.	"

OPTICAL CONSTANTS OF METALS

(Continued)

Metal	λ	$\overline{\phi}$	$\overline{\psi}$	Computed n	Computed k	Computed nk	Computed R	Authority
	μ	° ′	° ′					
Lead	.589	.....	.....	2.01	3.48	.....	62.	Drude
Magnesium	5.89	.....	.....	0.37	4.42	.....	93.	"
Manganese	5.79	.....	.....	2.49	3.89	.....	64.	Wartenburg, 1910
Mercury (liq.)	.326	.....	.....	0.68	2.26	.....	66.	Meier, 1903
	.441	.....	.....	1.01	3.42	.....	74.	"
	.589	.....	.....	1.62	4.41	.....	75.	"
	.668	.....	.....	1.72	4.70	.....	77.	"
Nickel	0.420	72 20	31 42	1 41	1.79	2.53	54.	Tool
	0.589	76 1	31 41	1.79	1.86	3.33	62.	Drude
	0.750	78 45	32 6	2.19	1.99	4.36	70.	Ingersoll
	1.00	80 33	32 2	2.63	2.00	5.26	74.	"
	2.25	84 21	33 30	3.95	2.33	9.20	85.	"
	.275	.....	.....	1.09	1.16	.....	24.	Meier, 1903
	.441	.....	.....	1.16	1.23	.....	25.	"
	.589	.....	.....	1.30	1.97	.....	43.	"
Platinum	1.00	75 30	37 00	1.14	3.25	3.7	....	Först-Fréed
	2.00	74 30	39 50	0.70	5.06	3.5	....	" "
	3.00	73 50	41 00	0.52	6.52	3.4	....	" "
	5.00	72 00	42 10	0.34	9.01	3.1	....	" "
Electrolytic	.257	.....	.....	1.17	1.65	.....	37.	Meier, 1903
	.441	.....	.....	1.84	3.16	.....	58.	"
	.589	.....	.....	2.63	3.54	.....	59.	"
	.668	.....	.....	2.91	3.66	.....	59.	"
Potassium	.665	65 27	43 56	.066	26.8	.....	93.8	Duncan, 191
	.589	62 58	43 42	.068	22.1	.....	92.	"
	.472	57 9	43 0	.070	14.3	.....	86.9	"
	.546	.....	.....	1.09	1.16	.....	24.	Morgan, 192
Rhodium	.579	.....	.....	1.54	4.67	.....	78.	Wartenburg, 1910
Selenium	.400	.....	.....	2.94	2.31	.....	44.	Wood
	.490	.....	.....	3.12	1.49	.....	35.	"
	.589	.....	.....	2.93	0.45	.....	25.	"
	.760	.....	.....	2.60	0.06	.....	20.	"
Silicon, 95%	pure							
	.579	75 38	.....	3.87	0.116	.....	35.7	Wartenburg 1910
	.589	.....	.....	4.18	0.09	.....	38.	Ingersoll
	1.25	.....	.....	3.67	0.08	.....	33.	"
	2.25	.....	.....	3.53	0.08	.....	31.	"
99.75% pure	0.589	76 45	.....	4.24	0.118	.....	37.8	Littleton, 19
Silver	0.226	62 41	22 16	1.41	0.75	1.11	18.	Minor
	.293	63 14	18 56	1.57	0.62	0.97	17.	"
	.316	52 28	15 38	1.13	0.38	0.43	4.	"
	.332	52 1	37 2	0.41	1.61	0.65	32.	"
	.395	66 36	43 6	0.16	12.32	1.91	87.	"
	.500	72 31	43 29	0.17	17.1	2.94	93.	"
	.589	75 35	43 47	0.18	20.6	3.64	95.	"
	.750	79 26	44 6	0.17	30.7	5.16	97.	Ingersoll
	1.00	82 0	44 2	0.24	29.0	6.96	98.	"
	1.50	84 42	43 48	0.45	23.7	10.7	98.	"
	2.25	86 18	43 34	0.77	19.9	15.4	99.	"
	3.00	87 10	42 40	1.65	12.2	20.1	....	Först-Fréed
	4.50	88 20	41 10	4.49	7.42	33.3	....	" "
Sodium	.665	72 11	44 29	0.051	55.0	.....	97.7	Duncan, 19
	.589	68 51	44 29	.044	55.0	.....	97.1	"
	.546	68 48	44 20	.052	42.6	.....	96.5	"

OPTICAL CONSTANTS OF METALS

(Continued)

Metal	λ	$\bar{\Phi}$	$\bar{\Psi}$	Computed n	Computed k	Computed nk	Computed R	Authority
	μ	° ′	° ′					
Sodium	.472	66 29	44 9	.057	33.3	.....	95.2	Duncan, 1913
	.435	66 0	44 6	.058	31.7	.....	94.8	"
(liq.)	.589	.....	.....	.004	2.61	.....	99.	Drude
(solid)	.546	.....	.....	.047	47.3	.....	96.9	Morgan, 1922
Sodium-Potassium								
17.3% K	.546	.....	.....	.081	27.2	.....	94.6	"
45. % K	.546	.....	.....	1.08	16.8	.....	90.4	"
66. % K	.546	.....	.....	.137	12.5	.....	87.0	"
74.2% K	.546	.....	.....	.124	12.8	.....	86.9	"
84.3% K	.546	.....	.....	.088	17.6	.....	90.2	"
Steel								
0.44% C	.589	77 15	.....	2.50	1.30	.....	57.4	Littleton, 1912
1.28% C	.589	77 22	.....	2.66	1.28	.....	57.5	"
3.5 % C	.589	77 35	.....	2.77	1.23	.....	57.0	"
	0.226	66 51	28 17	1.30	1.26	1.64	35.	Minor
	.257	68 35	28 45	1.38	1.35	1.86	40.	"
	.325	69 57	30 9	1.37	1.53	2.09	45.	"
	.500	75 47	29 2	2.09	1.50	3.14	57.	"
	.650	77 48	27 9	2.70	1.33	3.59	59.	Ingersoll
	1.50	81 48	28 51	3.71	1.55	5.75	73.	"
	2.25	83 22	30 36	4.14	1.79	7.41	80.	"
Tantalum	.579	.....	.....	2.05	2.31	.....	44.	Wartenburg
Tellurium								
axis horizontal	.590	.....	.....	3.07	.563	.....	34.	Van Dyke, 1922
axis vertical	.590	.....	.....	2.68	.632	.....	30.	Van Dyke, 1922
Tin	.589	.....	.....	1.48	5.25	.....	82.	Drude
Tungsten	.579	76 0	.....	2.76	0.98	.....	48.6	Wartenburg
	.589	78 31	.....	3.46	0.94	.....	54.5	Littleton, 1912
Vanadium	.579	.....	.....	3.03	3.51	.....	58.	"
Zinc	.257	.....	.....	0.55	0.61	.....	20.	Meier, 1903
	.441	.....	.....	0.93	3.19	.....	73.	"
	.589	.....	.....	1.93	4.66	.....	74.	"
	.668	.....	.....	2.62	5.08	.....	73.	"

DISPERSION

The dispersion for various types of optical glass is shown in the following table. n_D = index of refraction for the D line (of the solar spectrum) and n_F and n_C the index for the F and C lines respectively ($n_F - n_D$) shows the dispersion for these two wave lengths.

Glass.	n_D	$(n_F - n_C)$
Light phosphate crown	1.5159	.00737
Barium-silicate crown	1.5399	.00909
High-dispersion crown	1.5262	.01026
Borate flint	1.5686	.01102
Extra light flint	1.5398	.01142
Heavy flint	1.7174	.02434
Heaviest flint	1.9626	.04882

INDEX OF REFRACTION, AQUEOUS SOLUTIONS

Substance.	Density.	Temp. °C.	Index for $\lambda = .5893$ (Na)	Observer.
Ammonium chloride	1.067	27.05	1.379	Willigen
Ammonium chloride	1.025	29.75	1.351	Willigen
Calcium chloride	1.398	25.65	1.443	Willigen
Calcium chloride	1.215	22.9	1.397	Willigen
Calcium chloride	1.143	25.8	1.374	Willigen
Hydrochloric acid	1.166	20.75	1.411	Willigen
Nitric acid	1.359	18.75	1.402	Willigen
Potash (caustic)	1.416	11.0	1.403	Frauenhofer
Potassium chloride	Normal solution		1.343	Bender
Potassium chloride	Double normal		1.352	Bender
Potassium chloride	Triple normal		1.360	Bender
Soda (caustic)	1.376	21.6	1.413	Willigen
Sodium chloride	1.189	18.07	1.378	Schutt
Sodium chloride	1.109	18.07	1.360	Schutt
Sodium chloride	1.035	18.07	1.342	Schutt
Sodium nitrate	1.358	22.8	1.385	Willigen
Sulphuric acid	1.811	18.3	1.437	Willigen
Sulphuric acid	1.632	18.3	1.425	Willigen
Sulphuric acid	1.221	18.3	1.370	Willigen
Sulphuric acid	1.028	18.3	1.339	Willigen
Zinc chloride	1.359	26.6	1.402	Willigen
Zinc chloride	1.209	26.4	1.375	Willigen

INDEX OF REFRACTION OF METALS

For Sodium Light

(Drude.)

Metal.	Index of refraction.	Metal.	Index of refraction.
Aluminum	1.44	Mercury	1.73
Antimony	3.04	Nickel	1.79
Bismuth	1.90	Platinum	2.06
Cadmium	1.13	Silver	0.181
Copper	0.641	Steel	2.41
Gold	0.366	Tin, solid	1.48
Iron	2.36	Tin, fluid	2.10
Lead	2.01	Zinc	2.12
Magnesium	0.37		

INDEX OF REFRACTION, GASES

Values are relative to a vacuum and for a temp. of 0° C. and 760 mm. pressure.

(From Smithsonian Tables.)

Substance.	Kind of light.	Indices of refraction.	Observer.
Acetone	D	1.001079–1.001100	
Air	D	1.0002926	Perreau
Ammonia	white	1.000381–1.000385	
Ammonia	D	1.000373–1.000379	
Argon	D	1.000281	Rayleigh
Benzene	D	1.001700–1.001823	
Bromine	D	1.001132	Mascart
Carbon dioxide	white	1.000449–1.000450	
dioxide	D	1.000448–1.000454	
disulphide	white	1.001500	Dulong
disulphide	D	1.001478–1.001485	
monoxide	white	1.000340	Dulong
monoxide	white	1.000335	Mascart
Chlorine	white	1.000772	Dulong
Chlorine	D	1.000773	Mascart
Chloroform	D	1.001436–1.001464	
Cyanogen	white	1.000834	Dulong
Cyanogen	D	1.000784–1.000825	
Ethyl alcohol	D	1.000871–1.000885	
ether	D	1.001521–1.001544	
Helium	D	1.000036	Ramsay
Hydrochloric acid	white	1.000449	Mascart
Hydrochloric acid	D	1.000447	Mascart
Hydrogen	white	1.000138–1.000143	
Hydrogen	D	1.000132	Burton
sulphide	D	1.000644	Dulong
sulphide	D	1.000623	Mascart
Methane	white	1.000443	Dulong
Methane	D	1.000444	Mascart
Methyl alcohol	D	1.000549–1.000623	
Methyl ether	D	1.000891	Mascart
Nitric oxide	white	1.000303	Dulong
Nitric oxide	D	1.000297	Mascart
Nitrogen	white	1.000295–1.000300	
Nitrogen	D	1.000296–1.000298	
Nitrous oxide	white	1.000503–1.000507	
Nitrous oxide	D	1.000516	Mascart
Oxygen	white	1.000272–1.000280	
Oxygen	D	1.000271–1.000272	
Pentane	D	1.001711	Mascart
Sulphur dioxide	white	1.000665	Dulong
Sulphur dioxide	D	1.000686	Ketteler
Water	white	1.000261	Jamin
Water	D	1.000249–1.000259	

COEFFICIENT OF TRANSPARENCY OF UVIOL GLASS FOR THE ULTRA-VIOLET

For a thickness of 1 mm.

Wave length, microns	0.280	0.309	0.325	0.346	0.361	0.383	0.397
Uviol crown	0.56	0.95	0.990	0.996	0.999	1.000	1.000

REFLECTION OF LIGHT BY GLASS IN AIR

The table gives the per cent of the incident light which is reflected fro the surface of glass in air assuming an index of refraction of 1.55; i repr sents the angle of incidence and R the per cent of light reflected.

(Computed according to Fresnel's formula.)

i	R	i	R	i	R
0°	4.65				
5	4.65	35°	4.98	65°	12.91
10	4.66	40	5.26	70	18.00
15	4.66	45	5.73	75	26.19
20	4.68	50	6.50	80	39.54
25	4.73	55	7.74	85	61.77
30	4.82	60	9.73	90	100.

REFLECTION BY TRANSPARENT MEDIA IN AIR

For Normal Incidence

The table gives the per cent of the normally incident light which is r flected by transparent media of various indices of refraction. n = ind of refraction, R = reflected light, i = angle of incidence = 0.

(Computed from Fresnel's formula.)

n	R	n	R	n	R
1.0	0.00	1.7	6.72	2.4	17.0
1.1	0.23	1.8	8.16	2.5	18.4
1.2	0.83	1.9	9.63	2.6	19.8
1.3	1.70	2.0	11.11	2.7	21.1
1.4	2.78	2.1	12.6	2.8	22.5
1.5	4.00	2.2	14.1	2.9	23.8
1.6	5.33	2.3	15.5	3.0	25.0

COEFFICIENT OF TRANSPARENCY OF GLASS FOR TH INFRA-RED

Normal incidence. thickness 1 cm.

Wave length, microns	0.7	1.1	1.7	2.3	2.7	3.
Crown, borate	1.00	.55	.21	.025	.04	
borosilicate	..	.74	.61	.33	.034	.0
Flint, light	1.00	.91	.82	.45	.083	.0
heavy	1.00	1.00	1.00	1.00	.45	.0

REFLECTION OF LIGHT BY METALS

The table gives the per cent of normally incident light which is reflected by the polished surface of various metals.

Wave length.	Antimony.	Bronze (68Cu, 68Sn).	Copper, commercial.	Gold, electrolytic.	Iron.	Magnalium, Mach's.	Magnesium.	Mercury, backed glass.
.251	....	.30	25.9	38.8	....	67.0		
.288	....	....	24.3	34.0	....	70.6		
.305	....	....	25.3	31.8	....	72.2		
.326	....	....	24.9	28.6	....	75.5		
.357	....	....	27.3	27.9	....	81.2		
.385	....	.53	28.6	27.1	....	83.9		
.420	....	....	32.7	29.3	....	83.3		
.450	....	....	37.0	33.1	....	83.4	....	72.8
.500	....	.63	43.7	47.0	.55	83.3	.72	70.9
.550	....	....	47.7	74.0	....	82.7	....	71.2
.600	.53	.64	71.8	84.4	.57	83.0	.73	69.9
.650	....	....	80.0	88.9	....	82.7	....	71.5
.700	....	....	83.1	92.3	.59	83.3	....	72.8
.800	....	....	88.6	94.9	....	84.3		
1.00	.55	.70	90.1	.....	.65	84.1	.74	
2.0	.60	.80	95.5	96.8	.78	86.7	.77	
3.0	.65	.86	97.1	.....	.84	87.4	.80	
4.0	.68	.88	97.3	96.9	.89	88.7	.83	
9.0	.72	.93	98.4	98.0	.94	90.6	.93	

Wave length.	Nickel, electrolytic.	Platinum, electrolytic.	Silver, chemically deposited.	Silver-backed glass.	Speculum metal.	Steel.	Tungsten.
.251	37.8	33.8	34.1	.....	29.9	32.9	
.288	42.7	38.8	21.2	.....	37.7	35.0	
.305	44.2	39.8	9.1	.....	41.7	37.2	
.326	45.2	41.4	14.6	.....	.....	40.3	
.357	48.8	43.4	74.5	.....	51.0	45.0	
.385	49.6	45.4	81.4	.....	53.1	47.8	
.420	56.6	51.8	86.6	.....	56.4	51.9	
.450	59.4	54.7	90.5	85.7	60.0	54.4	
.500	60.8	58.4	91.3	86.6	63.2	54.8	.49
.550	62.6	61.1	92.7	88.2	64.0	54.9	
.600	64.9	64.2	92.6	88.1	64.3	55.4	.51
.650	66.6	66.5	94.7	89.1	65.4	56.4	
.700	68.8	69.0	95.4	89.6	66.8	57.6	.54
.800	69.6	70.3	96.8	.....	.....	58.0	
1.00	72.0	72.9	97.0	.....	70.5	63.1	.62
2.0	83.5	80.6	97.8	.....	80.4	76.7	.85
3.0	88.7	88.8	98.1	.....	86.2	83.0	.90
4.0	91.1	91.5	98.5	.....	88.5	87.8	.93
9.0	95.6	95.4	98.7	.....	92.2	92.9	.95

REFLECTION OF LIGHT BY METALS

The table gives the percent of normally incident light which is reflected b the polished surface of various metals.

Coblentz, 1906, 1911.

Wave length	Alum-inum	Cad-mium	Cobalt	Graph-ite	Irid-ium	Molyb-denum	Pallad-ium	Rhod-ium	Silicc
.5	..	..	..	22	..	46	..	76	34
.6	..	..	..	24	..	48	..	77	32
.8	..	..	..	25	..	52	..	81	29
1.0	71	72	67	27	78	58	72	84	28
2.0	82	87	72	35	87	82	81	91	28
4.0	92	96	81	48	94	90	88	92	28
7.0	96	98	93	54	95	93	94	94	28
10.0	98	98	97	59	96	94	97	95	28
12.0	98	99	97	..	96	95	97	..	..

Wave length	Tanta-lum	Telur-ium	Tin	Vanad-ium	Zinc	Wave length	Tung-sten*	Stellite
.5	38	..	..	57	..	.15	....	.32
.6	45	49	..	58	..	.20	....	.42
.8	64	48	..	60	..	.30	....	.50
1.0	78	50	54	61	80	.50	.50	.64
2.0	90	52	61	69	92	.75	.52	.67
4.0	93	57	72	79	97	1.00	.576	.689
7.0	94	68	81	88	98	2.00	.900	.747
10.0	..	..	84	..	98	3.00	.943	.792
12.0	95	..	85	..	99	4.00	.948	.825
						5.00	.953	.848
						9.00	....	.880

* Coblentz, Emerson, 1917

RELATIVE STIMULATION OF THE THREE PRIMAR COLOR SENSATIONS BY DIFFERENT WAVE LENGTH

Wave length...	0.36μ	0.38	0.40	0.42	0.44	0.46	0.48	0.50	0.52	0.
Red.....	0.0	0.0	2.0	1.0	1.0	1.0	3.0	9.0	23.0	39.
Green.....	0.0	0.0	0.0	0.0	0.0	2.0	7.0	23.0	61.0	87.
Blue.....	0.0	10.5	29.0	52.0	76.0	78.0	68.0	46.0	16.0	7.

Wave length...	0.56μ	0.58	0.60	0.62	0.64	0.66	0.68	0.70	0.72	0.
Red.....	56.0	69.0	71.5	59.0	30.0	12.0	5.0	2.0	1.0	0.
Green.....	86.0	67.0	37.0	10.0	2.5	1.0	0.0	0.0	0.0	0.
Blue.....	4.0	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.

REFLECTION OF LIGHT BY METALS (Continued)

Coblentz, Bulletin 379, Bureau of Standards 1920

Wave-length in μ — 0.001mm.	Silver	Monel metal	Stellite	Zinc
0.45	88.0	56.5	63.5	54.0
0.50	90.0	57.8	65.8	55.0
0.55	91.5	59.0	68.3	56.0
0.60	92.7	60.2	70.1	57.5
0.65	93.5	61.8	71.0	60.0
0.70	94.1	63.7	71.8	61.0
0.75	94.7	65.6	72.4	61.5
0.80	95.1	67.2	73.0	61.5
0.90	96.0	70.0	73.5	55.5
0.95	96.3	71.1	....	51.0
1.00	96.5	72.3	74.0	49.0
1.05	96.7	73.0	....	53.5
1.10	96.9	73.6	....	62.5
1.20	97.2	74.8	74.5	74.7
1.40	97.4	77.0	75.0	85.8
1.50	97.6	78.2	75.3	88.4
1.75	97.8	81.2	76.0	92.0
2.00	97.9	83.8	76.8	94.0
2.50	98.0	87.0	78.6	95.3
3.00	98.0	88.7	80.0	95.5
3.50	98.0	89.5	81.4	95.8
4.00	98.0	91.0	82.8	96.2

TRANSMISSION FACTORS FOR "GROUND" GLASS

Luckiesch

	Side toward light	Transmission Factor	
		Narrow beam	Diffuse
Sand blasted	Rough	0.783	0.702
	Smooth	.739	.695
Etched, fine	Rough	.794	.709
	Smooth	.758	.704

DIFFUSE REFLECTING POWER

The diffuse reflecting power, or ratio of total luminous flux reflected to that received, measured for the various regions of the spectrum. The wave lengths given are those of maximum energy. — Coblentz, Bulletin, 196, Bureau of Standards 1912.

Material	Reflecting power %					
	0.54 μ	0.60	0.95	4.4	8.8	24.0
Lampblacks						
paint	....	3.2	3.4	3.2	3.8	4.4
paraffin-candle	....	.....	0.97	....	.....	....
rosin	....	.....	1.3	1.3	.....	3.0
sperm candle	....	.....	1.1	.9	1.3	4.0
camphor	....	.....	1.3	1.2	1.6	5.7
acetylene	....	.....	0.6	.8	1.2	2.1
Platinum black						
electrolytic	....	.....	1.1	1.4	2.1	4.2
Pigments						
cobalt oxide, Co_2O_3	....	3.02	3.92	13.9	14.6	5.9
	....	.....	4.04	....	11.8	....
	....	.....	2.49	....	.....	....
copper oxide, CuO	....	.....	23.5	15.2	.....	4.4
chromium oxide, Cr_2O_3	24.1	27.0	44.6	32.9	5.0	8.2
lead oxide, PbO	....	51.8	.....	50.6	25.6	9.5
red iron oxide, Fe_2O_3	....	26.3	41.0	29.9	3.7	9.1
yttrium oxide, Y_2O_3	....	73.8	.....	34.4	11.1	10.0
lead chromate, $PbCrO_4$	61.2	70.2	.....	41.2	4.74	7.4
aluminum oxide, Al_2O_3	....	84.1	87.7	20.8	2.34	6.5
					1.64	....
thorium oxide, ThO_2	....	86.0	.....	46.9	7.11	10.0
zinc oxide, ZnO	....	82.2	86.4	8.5	3.2	5.1
					2.1	
magnesium oxide, MgO	....	86.3	.....	16.0	2.5	9.1
calcium oxide, CaO	....	85.4	.....	22.3	3.6	6.2
zirconium oxide, ZrO_2	82.2	85.8	84.1	23.2	5.1	5.4
		86.8	90.8	29.2	9.3	6.9
lead carbonate, $PbCO_3$	....	89.9	92.8	....	.....	....
		.....	94.5	....	13.2	....
magnesium carbonate, $MgCO_3$	....	85.2	89.4	10.8	4.1	8.8
Paints						
white lead No. 103	....	76.2	79.3	....	.....	....
" " " 102	....	74.3	.....	....	.....	....
zinc lead white No. 107	....	69.6	.....	....	.....	....
" oxide No. 104	....	68.1	72.1	....	.....	....
white lead 50% / zinc oxide 50% } No. 209	....	70.8	.....	....	.....	....
Miscellaneous						
asphalt (pavement)	....	14.8	.....	....	.....	....
black felt	....	13.9	21.2	....	.....	....
	....	22.5	25.6	....	.....	....
black velvet	....	1.75	.....	3.66	2.7	....
bluestone (sandstone) SiO_2	....	18.4	8.1	17.6	11.0	....
blue flannel	....	17.5	.....	....	.....	....
Brick:						
light buff	....	48.4	.....	....	.....	....
darker	....	40.0	.....	....	.....	....
red brick	....	30.1	.....	....	12.4	....
darker & glazed	....	23.4	.....	....	.....	....
Cotton cloth:						
diamine fast red 8 B L	....	43.8	.....	....	.....	....
diamine fast black C B —	....	33.1	.....	....	.....	....
columbia fast black R	....	28.7	.....	....	.....	....
diamine aldehyde black	....	29.5	.....	....	.....	....
sulphur black A W L —	....	2.43	2.57	....	.....	....

DIFFUSE REFLECTING POWER (Continued)

The diffuse reflecting power, or ratio of total luminous flux reflected to that received, measured for the various regions of the spectrum. The wave lengths given are those of maximum energy. — Coblentz, Bulletin, 196, Bureau of Standards 1912.

Material	Reflecting power %					
	0.54 μ	0.60	0.95	4.4	8.8	24.0
Woolen Cloth:						
lanacyl blue B N —		25.1				
salacine blue black A E —		14.6	17.8			
" black PB —		11.8	15.1			
Linen:						
starched, dull finish		81.2				
deep blue cloth (Navy Dept.)		17.0				
lighter shade		18.2				
Feldspar, $KAlSi_3O_8$			86.7	38.2	10.3	9.7
cleavage surface		39.4			14.6	
Granolith (pavement)		16.9				
Green Leaf (tulip tree)		21.9	38.0	5.6		
Indiana limestone, $CaCO_3$		42.9		20.3	5.0	
Quartz (powder, French Flint) SiO_2		81.0	41.5	7.9	9.0	
Slate (dark clay)		6.7		13.4	20.0	
White marble $CaCO_3$ ground, unpolished		53.5		6.4	5.1	
cleavage, surface		40.8				
White paper		71.7	74.7	18.2	5.0	
two thicknesses		73.4				
White paper, (Bond)		75.2				

DIFFUSED REFLECTION

Albedo

Giving the percent of diffused reflection of "white light" for various surfaces. *Sumpner, Zöllner* and others.

Material	Reflections	Material	Reflections
Wood, pine	40	Parchment	
Cardboard		1 sheet	22
yellow	30	2 sheets	35
white	60–70	Cloth	
Painted surface,		black	1
yellow	40	tracing	35
white washed	50	white	60–70
Paper		Velvet	
tracing	22	black	0.4
ordinary white	60–70		
blotting	70–80	Loam, sandy	24
chocolate color	4		
brown	13	Earth, moist	8
blue	25		
yellow	25	Marl, argillaceous	16

PIGMENTS AND DYES

The tables which follow give the percent of incident light reflected by pigments or transmitted by dyes. The pigments were in dry powdered form and the dye solutions, except where indicated, in distilled water. Wave lengths are given in microns.

(*Luckiesch, 1917*)

Pigment	0.44	.46	.48	.50	.52	.54	.56	.58	.60	.62	.64	.66	.68	.70
American vermilion	0.08	0.06	0.05	0.05	0.06	0.06	0.09	0.11	0.24	0.39	0.53	0.61	0.66	0.65
Venetian red	.05	.05	.05	.05	.05	.06	.07	.12	.19	.24	.28	.30	.32	.32
Tuscan red	.07	.07	.07	.08	.08	.08	.08	.12	.16	.18	.20	.22	.23	.24
Indian red	.08	.07	.07	.07	.07	.07	.07	.11	.15	.18	.20	.22	.23	.24
Burnt sienna	.04	.04	.04	.04	.05	.06	.09	.14	.18	.20	.21	.23	.24	.25
Raw sienne	.12	.13	.13	.13	.18	.26	.35	.43	.46	.46	.45	.44	.45	.43
Golden ochre	.22	.22	.23	.27	.40	.53	.63	.71	.75	.74	.73	.73	.73	.72
Chrome yellow, ochre	.08	.09	.07	.07	.10	.19	.30	.46	.60	.62	.66	.82	.81	.80
Yellow ochre	.20	.20	.21	.24	.32	.42	.53	.63	.64	.61	.60	.59	.59	.59
Chrome yellow (medium)	.05	.05	.06	.08	.18	.48	.66	.75	.78	.79	.81	.81	.81	.81
Chrome yellow (light)	.13	.13	.18	.30	.56	.82	.88	.89	.90	.89	.88	.87	.85	.84
Chrome green (light)	.10	.10	.14	.23	.26	.23	.20	.17	.14	.11	.09	.08	.07	.06
Chrome green (medium)	.07	.07	.10	.21	.21	.17	.13	.11	.09	.07	.06	.06	.06	.05
Cobalt blue	.59	.58	.49	.35	.23	.15	.11	.10	.10	.10	.11	.15	.20	.25
Ultramarine blue	.67	.54	.38	.21	.10	.06	.04	.03	.03	.04	.05	.07	.10	.17

PIGMENTS AND DYES (Continued)

Red Dyes

Dye-Solution	0.44	.46	.48	.50	.52	.54	.56	.58	.60	.62	.64	.66	.68	70
Carmen ruby opt	....	....	....	....	....	....	....	....	....	0.04	0.18	0.37	0.49	0.60
Amido naphthol red	....	....	....	....	....	....	....	....	0.04	.38	.75	.92	.96	.96
Coccinine	....	....	....	....	....	....	....	0.04	.56	.96	.98	.98	.98	.98
Erythrosine	0.06	....	....	....	....	....	0.10	.53	.90	.95	.96	.96	.96	.96
Hematoxyline	.01	0.03	0.07	0.13	0.14	0.12	.13	.25	.44	.54	.63	.73	.78	.82
"	....	....	....	....	....	....	....	.01	.02	.04	.09	.15	.21	.25
Alizarine red	.01	.01	.02	.03	.04	.06	.11	.22	.39	.54	.65	.72	.77	.79
Acid rosolic (pure)	.04	.03	.01	....	....	....	.02	.38	.78	.88	.90	.91	.92	.92
Rapid filter red	....	....	....	....	....	.01	.10	.47	.86	.95	.96	.96	.96	.96
Aniline red fast extra A	....	....	....	....	....	.02	.12	.34	.55	.72	.84	.88	.90	.92
Pinatype red fast	....	....	....	....	....	....	....	....	.11	.35	.55	.65	.68	.69
Eosine (yellowish)	....	....	....	....	....	....	....	....	.06	.40	.63	.74	.82	.85
Eosine	....	....	....	....	....	....	.01	.54	.87	.93	.92	.92	.92	.92
Naphthalinrot in absolute alcohol	....	....	....	....	....	....	....	....	.06	.28	.43	.50	.57	.61
Rose bengal	.80	.70	.34	.06	.01	....	.14	.82	.96	.97	.98	.98	.98	.98
Rose bengal	.01	....	....	....	....	....	....	.09	.57	.83	.89	.92	.94	.96
Cobalt ammonium sulphate	.60	.56	.48	.37	.38	.53	.70	.82	.86	.90	.90	.90	.90	.89
Cobalt nitrate	.69	.51	.40	.31	.32	.48	.67	.82	.87	.90	.90	.90	.90	.90

PIGMENTS AND DYES (Continued)

Yellow Dyes

Dye-Solution	0.44	.46	.48	.50	.52	.54	.56	.58	.60	.62	.64	.66	.68	.70
Tartrazine	....	....	....	....	0.07	0.52	0.75	0.86	0.91	0.95	0.96	0.97	0.98	0.98
Chrysoidin	....	....	....	....	....	....	....	....	.02	.23	.50	.71	.79	.79
Aurantia	....	....	....	....	....	.03	.23	.53	.82	.92	.96	.96	.96	.96
Aniline yellow phosphine	....	....	....	....	.02	.20	.43	.60	.67	.75	.81	.85	.86	.87
Fluorescein	0.15	0.01	....	....	.48	.91	.97	.98	.98	.98	.98	.98	.98	.98
Aniline yellow fast, S	....	....	0.01	0.07	.43	.84	.96	.96	.96	.96	.96	.96	.96	.96
Methyl orange, indicator	....	....	....	....	....	....	.01	.31	.70	.79	.80	.81	.81	.81
Auramin	....	....	.01	.39	.77	.83	.84	.86	.87	.88	.90	.92	.93	.93
Uranine	.15	.01	....	.01	.58	.96	.97	.97	.97	.97	.97	.97	.97	.97
Uranine naphthaline	....	....	....	.04	.53	.77	.82	.83	.84	.85	.86	.86	.87	.87
Orange B Naphthol	....	....	....	....	....	.01	.43	.88	.95	.96	.97	.97	.97	.97
Safranine	....	....	....	....	....	....	....	....	.03	.27	.64	.85	.93	.93
Martius gelb	....	....	....	.01	.43	.84	.91	.94	.95	.95	.95	.95	.95	.95
Naphthol yellow	....	....	.01	.18	.74	.91	.96	.97	.98	.98	.98	.98	.98	.98
Potassium bechromate, sat. sol.	....	....	....	....	....	.10	.60	.84	.88	.89	.89	.89	.89	.88
Cobalt chromate	.17	.36	.62	.82	.88	.90	.92	.93	.95	.96	.96	.96	.96	.95

PIGMENTS AND DYES (Continued)

Green Dyes

Dye-Solution	0.44	.46	.48	.50	.52	.54	.56	.58	.60	.62	.64	.66	.68	.70
Naphthol green	0.02	0.04	0.07	0.21	0.30	0.36	0.29	0.16	0.07	0.02	0.01	....	....	....
Brilliant green	.04	.39	.69	.52	.23	.04	....	....	....	....	....	0.02	0.23	0.64
Filter blue green	.35	.49	.64	.70	.60	.37	.13	.02	....	....	....	....	....	....
Filter blue green	.06	.14	.23	.40	.26	.08	.01	....	....	....	....	....	....	....
Malachite green	....	.12	.20	.08	.01	....	....	....	....	....	....	....	.12	.50
Malachite green	....	.01	.04	.01	....	....	....	....	....	....	....	....	.02	.23
Malachite green	....	....	.01	....	....	....	....	....	....	....	....	....	....	.10
Saurgrun	.03	.29	.57	.57	.39	.19	.04	.01	....	....	....	....	.04	.30
Methylengrun	.28	.31	.32	.26	.17	.07	.02	.01	....	....	....	....	.03	.28
Methylengrun	.14	.16	.17	.13	.06	.01	....	....	....	....	....	....	.02	.14
Aniline green naphthol B	.02	.06	.14	.24	.34	.40	.32	.14	.04	.01	....	....	....	....
Aniline green naphthol B	....	....	.02	.06	.10	.15	.09	.02	....	....	....	....	....	....
Neptune green	....	.40	.63	.41	.13	.01	....	....	....	....	....	....	....	.05
Neptune green	....	.19	.36	.18	.02	....	....	....	....	....	....	....	....	.02
Cupric chloride	.77	.84	.89	.92	.92	.89	.80	.67	.52	.36	.19	.06	.02	....

Blue Dyes

Dye-Solution	0.44	.46	.48	.50	.52	.54	.56	.58	.60	.62	.64	.66	.68	.70
Trunbulls' blue	0.58	0.60	0.56	0.51	0.38	0.28	0.18	0.09	0.05	0.03	0.01	....	....	....
Victoria blau	.52	.23	.09	.01	....	....	....	....	....	.01	.04	0.21	0.49	0.73
Prussian blue (soluble)	.66	.71	.76	.69	.60	.46	.32	.20	.12	.07	.05	.03	.03	....
" " "	.06	.09	.09	.05	.02	.01	....	....	....	....	....	....	....	....
Wasser blau	.89	.75	.51	.26	.07	.01	....	....	.01	.02	.06	.18	.37	.60
" "	.85	.66	.42	.17	.03	.01	....	....	....	.01	.03	.10	.26	.48
Resorcine blue	.25	.18	.06	.02	.01	....	....	....	.01	.02	.14	.41	.64	.72
Toluidin blau	.66	.31	.13	.03	.01	....	....	....	....	....	.01	.04	.16	.40
Patent blue	.83	.91	.84	.76	.65	.46	.24	.08	.02	....	....	.06	.42	.78
" "	.15	.25	.17	.05	....	....	....	....	....	....	....	....	....	.12
Dianil "	.77	.69	.59	.48	.35	.24	.15	.09	.05	.05	.07	.14	.29	.53
" "	.38	.30	.18	.10	.04	.01	....	....	....	....	....	....	.02	.12
Filter "	.84	.79	.66	.44	.27	.17	.14	.19	.36	.56	.74	.81	.88	.92
" "	.35	.29	.18	.04	....	....	....	....	.02	.08	.23	.44	.62	.71
Aniline blue, methyl	.92	.88	.78	.52	.27	.09	.03	.02	.02	.04	.08	.16	.25	.45
" " "	.44	.31	.13	....	....	....	....	....	....	....	....	....	....	....

PIGMENTS AND DYES (Continued)

Purple Dyes

Dye-Solution	0.44	.46	.48	.50	.52	.54	.56	.58	.60	.62	.64	.66	.68	.70
Ethyl violet in gelatine (dry)	0.97	0.87	0.67	0.28	0.04	....	....	....	....	0.05	0.33	0.73	0.88	.91
Ethyl violet in gelatine (wet)	.83	.79	.45	.07	.01	....	0.01	0.03	0.05	15	.42	.76	.91	.93
Magenta	.21	.08	.02	.01	....	....	.01	.22	.73	.93	.97	.97	.97	.97
"	....	....	....	....	....	....	....	....	.07	.48	.81	.92	.95	.95
Gentian violet	.89	.83	.64	.44	.26	0.19	.15	.10	.13	.42	.75	.92	.93	.94
"	.11	.01	....	....	....	....	....	....	....	....	.01	.15	.48	.66
Rosazeine	.50	.28	.02	....	....	....	....	.06	.55	.90	.98	.98	.98	.98
"	....	....	....	....	....	....	....	....	....	.07	.54	.90	.95	.95
Iodine (dense)	....	....	....	....	....	....	....	....	....	....	.01	.03	.11	.23
Rhodamine B	.81	.71	.45	.13	.02	....	....	.23	.83	.96	.96	.96	.95	.94
Acid violet	.84	.76	.68	.50	.33	.26	.27	.34	.49	.70	.84	.96	.96	.96
"	.29	.08	.01	....	....	....	....	.01	.09	.32	.63	.84	.94	.94
Cyanine in alcohol	.07	.01	....	....	....	....	....	....	....	....	....	.01	.13	.23
Xylene red	.39	.23	.01	....	....	....	....	.01	.27	.79	.97	.97	.97	.96
"	....	....	....	....	....	....	....	....	.01	.31	.79	.96	.96	.95
Methyl violet B	.25	.04	....	....	....	....	....	....	....	....	.03	.26	.63	.89

TRANSMISSION OF ULTRA-VIOLET, VISIBLE AND INFRA-RED RADIATION BY VARIOUS NEUTRAL AND COLORED GLASSES

The following Table gives the fraction of the incident radiation transmitted by various glasses for specific thicknesses. Transmission for other thicknesses may be determined approximately by the following relation.

$$T \times 1.09 = tx$$

where T is the transmission (tabular value) for any sample: t, the transmittance for unit thickness; and x the thickness of the sample. The factor 1.09 is a correction for the loss by reflection at the two surfaces. The value of t should be computed from the tabular values of T and x, and used in the same equation to compute the transmission for other thicknesses.

A tabular value of the transmission "0" indicates that the transmission was below measurable limits at and beyond the particular wave length. A "...." indicates that the transmission at or beyond the particular wavelength was not measured.

Compiled from data published by the Bureau of Standards—Jena Glass Works, Corning Glass Works, and others.

Makers: A. O. C., American Optical Co.; B. & L., Bausch & Lomb; C. G. W., Corning Glass Works; C. E. S., Chicago Eye Shield Co.; H., F. A. Hardy & Co.; K., Julius King Optical Co.; W. & O., Wall and Ochs.

SECTION I

VARIOUS NEUTRAL AND COLORED GLASSES FOR THE ULTRA-VIOLET AND VISIBLE

	Crown	Ultra	Ultra	Pyrex	Mirror plate
Designation....	1.50	G 174 S	G 174 S	....	....
Maker.....	A. O. Co.	C. G. W.	C. G. W.	C. G. W.	B. & L.
Color.....	Colorless	Colorless	Colorless	Nearly colorless	Nearly neutral
Thickness, mm.	1.68	0.39	3.49	0.77	21.01
Wave length, microns					
0.22	....	....	....	....	....
.24	....	0	....	....	....
.26	....	.01	....	....	....
.28	0	.25	0	0	....
.30	.10	.58	.05	.05	....
.32	.56	.77	.50	.40	0
.34	.83	.86	.78	.70	.06
.36	.89	.89	.87	.82	.48
.38	.91	.92	.90	.87	.59
.40	.92	.92	.91	.88	.80
.42	.92	.92	.91	.89	.82
.44	.92	.92	.91	.90	.82
.46	.92	....	.91	.90	.84
.48	.92	....	.90	.90	.85
.50	.92	....	.90	.90	.86
.52	.92	....	.89	.91	.86
.54	.92	....	.89	.91	.85
.56	.92	....	.88	.91	.86

TRANSMISSION OF ULTRA-VIOLET, VISIBLE AND INFRA-RED RADIATION BY VARIOUS NEUTRAL AND COLORED GLASSES (Continued)

SECTION I (Continued)

	Crown	Ultra	Ultra	Pyrex	Mirror plate
Designation....	1.50	G 174 S	G 174 S	....	....
Maker.....	A. O. Co.	C. G. W.	C. G. W.	C. G. W.	B. & L.
Color.....	Colorless	Colorless	Colorless	Nearly colorless	Nearly neutral
Thickness, mm.	1.68	0.39	3.49	0.77	21.01
Wave length, microns					
.58	.92	....	.88	.91	.84
.60	.92	....	.87	.91	.83
.62	.92	....	.87	.91	.82
.64	.92	....	.87	.91	.82
.66	.92	....	.86	.91	.81
.68	.92	....	.86	.91	.81
.70	....	....	.85	.91	.80
.72	....	....	....	....	....

TRANSMISSION OF ULTRA-VIOLET, VISIBLE AND INFRA-RED RADIATION BY VARIOUS NEUTRAL AND COLORED GLASSES (Continued)

SECTION I (Continued)

	* Corex	* Vitaglass			
Designation...	G 980 A	....	* G 984 B	* G 985 B	* G 986 A
Maker.....	C. G. W.	....	C. G. W.	C. G. W.	C. G. W.
Color.....	Colorless	Colorless	Green	Blue	D. purple
Thickness, mm.	1.00	1.02	....	....	....
Wave length, microns					
0.22	0.37	....	....	0	....
.24	.58	....	0	.02	0
.26	.74	0	.38	.18	.08
.28	.83	.18	.34	.46	.36
.30	.87	.50	.12	.68	.64
.32	.92	.72	.36	.78	.76
.34	....	.86	.73	.84	.79
.36	....	.92	.79	.86	.76
.38	....	....	.75	.86	.52
.40	....	....	.45	.81	.05
.42	....	....	.11	.67	0
.44	....	....	.02	.41	....
.46	....	....	.01	.16	....
.48	....	....	.03	.04	....
.50	....	....	....	....	....
.52	....	....	....	....	....
.54	....	....	....	....	....
.56	....	....	....	....	....
.58	....	....	....	....	....
.60	....	....	....	....	....
.62	....	....	....	....	....
.64	....	....	....	....	....
.66	....	....	....	....	....
.68	....	....	....	....	....
.70	....	....	....	....	....
.72	....	....	....	....	....

* Special Ultra-violet Transmitting Glasses.

TRANSMISSION OF ULTRA-VIOLET, VISIBLE AND INFRA-RED RADIATION BY VARIOUS NEUTRAL AND COLORED GLASSES (Continued)

SECTION I (Continued)

	Canary	Canary	Ry. signal		
Designation....	"G 371"	"G 371"	"Yellow 100%"	"G 36 190%"	"G 361 CE"
Maker.....	C. G. W.	C. G. W.	C. G. W.	C. G. W.	C. G. W.
Color.....	Yellow	Yellow	Yellow	Yellow	Yellow
Thickness, mm.	0.99	5.79	1.12	0.60	3.04
Wave length, Microns		See also Jena G G 12			
0.22	....	....	....	....	....
.24	....	....	....	....	....
.26	....	....	....	....	....
.28	....	....	....	....	....
.30	....	....	....	....	....
.32	0	....	0	....	....
.34	.10	0	.02	0	....
.36	.67	.15	.09	.01	....
.38	.71	.26	.15	.02	....
.40	.52	.04	.15	.05	....
.42	.47	.02	.14	.08	....
.44	.55	.15	.17	.19	....
.46	.79	.35	.23	.37	0
.48	.80	.46	.30	.58	.15
.50	.84	.54	.40	.75	.60
.52	....	.82	.51	.85	.77
.54	....	.85	.60	.89	.82
.56	....	.85	.68	.90	.84
.58	....	.86	.73	.90	.85
.60	....	.86	.77	.90	.85
.62	....	.86	.78	.89	.85
.64	....	.86	.80	.89	.85
.66	....	.87	.81	.88	.85
.68	....	.88	.82	.88	.84
.70	....	.89	.82	.88	.83
.72	....	....	....	....	....

TRANSMISSION OF ULTRA-VIOLET, VISIBLE AND INFRA-RED RADIATION BY VARIOUS NEUTRAL AND COLORED GLASSES (Continued)

SECTION I (Continued)

Designation...	G 34 B 143 %	G 124 J	G 171 IZ	Signal Green 100 %	401 Z
Maker.....	C. G. W.	C. G. W.	C. G. W.	C. G. W.	C. G. W.
Color.....	Orange	Blue-green	Blue-green	Green	Green
Thickness, mm.	1.13	1.04	3.12	0.92	2.22
Wave length, microns					
0.22	....	....	....	....	....
.24	....	....	....	....	....
.26	....	....	....	....	....
.28	....	....	....	....	....
.30	....	....	....	....	....
.32	....	0	0	0	....
.34	....	.39	.05	.05	0
.36	....	.75	.35	.30	.20
.38	....	.82	.67	.55	.47
.40	....	.85	.83	.68	.67
.42	....	.86	.87	.76	.76
.44	....	.87	.89	.79	.79
.46	....	.88	.90	.82	.80
.48	....	.88	.89	.83	.80
.50	0	.88	.87	.82	.76
.52	.08	.88	.83	.79	.70
.54	.58	.88	.79	.73	.60
.56	.78	.87	.73	.64	.49
.58	.81	.85	.65	.55	.37
.60	.82	.83	.57	.46	.27
.62	.81	.79	.49	.38	.18
.64	.80	.77	.43	.32	.13
.66	.79	.73	.38	.26	.08
.68	.78	.68	.36	.21	.06
.70	.77	.66	.34	.18	....
.72	....	....	....	....	....

TRANSMISSION OF ULTRA-VIOLET, VISIBLE AND INFRA-RED RADIATION BY VARIOUS NEUTRAL AND COLORED GLASSES (Continued)

SECTION I (Continued)

Designation....	G 584	G 585	"G 34"	"G 341 F"	"G 24"
Maker.....	C. G. W.	C. G. W.	C. G. W.	C. G. W.	C. G. W.
Color.....	Green	Blue	Orange	Orange	Red
Thickness, mm.	4.1	0.28	1.50	2.12	0.88
Wave length, microns					
0.22	....	....	....	....	....
.24	....	....	....	....	....
.26	....	0	....	....	....
.28	....	.10	....	....	....
.30	....	.54	....	....	....
.32	0	.79	....	....	....
.34	.01	.87	....	....	....
.36	.30	.90	....	....	....
.38	.55	.91	....	....	....
.40	.66	.91	....	....	....
.42	.72	.90	....	....	....
.44	.75	.87	....	....	....
.46	.75	.83	....	....	....
.48	.73	.74	....	....	....
.50	.68	.60	....	....	....
.52	.57	.47	0	0	....
.54	.41	.41	.10	.01	....
.56	.23	.50	.74	.28	....
.58	.11	.35	.83	.73	0
.60	.05	.29	.85	.79	.02
.62	.02	.31	.87	.81	.30
.64	.01	.30	.87	.82	.80
.66	0	.35	.88	.82	.86
.68	....	.43	.87	.82	.87
.70	....	.53	....	.82	.86
.72	....	....	....	....	....

TRANSMISSION OF ULTRA-VIOLET, VISIBLE AND INFRA-RED RADIATION BY VARIOUS NEUTRAL AND COLORED GLASSES (Continued)

SECTION I (Continued)

	Signal red		Sextant green		
Designation....	Ruby 100%	G 20	....	G 585	G 50 77%
Maker.....	C. G. W.	C. G. W.	C. G. W.	C. G. W.	C. G. W.
Color.....	Red	Red	Green	Blue	Blue
Thickness, mm.	0.90	7.2	1.66	4.62	0.98
Wave length, microns					
0.22	....	....	....	....	....
.24	....	....	....	....	....
.26	....	....	....	....	....
.28	....	....	....	....	....
.30	....	....	....	0	0
.32	....	....	....	.25	.02
.34	....	....	....	.75	.35
.36	....	....	....	.85	.67
.38	....	....	....	.85	.80
.40	....	....	....	.78	.87
.42	....	....	0	.60	.89
.44	....	....	.04	.39	.88
.46	....	....	.13	.16	.86
.48	....	....	.28	.01	.81
.50	....	....	.42	0	.71
.52	....	....	.50	....	.56
.54	....	....	.46	....	.47
.56	....	....	.34	....	.50
.58	....	....	.21	....	.40
.60	0	0	.11	....	.32
.62	.78	.08	.05	....	.32
.64	.80	.20	.03	....	.28
.66	.87	.62	.02	....	.31
.68	.87	.77	....	0	.43
.70	.85	.73	....	.12	.53
.72	....	....	....	.57	....

TRANSMISSION OF ULTRA-VIOLET, VISIBLE AND INFRA-RED RADIATION BY VARIOUS NEUTRAL AND COLORED GLASSES (Continued)

SECTION I (Continued)

	Signal blue	Signal purple			
Designation....	Blue 100%	Purple 100%	G 53	G 55	G 55 A 80%
Maker.....	C. G. W.	C. G. W.	C. G. W.	C. G. W.	C. G. W.
Color.....	Blue	Blue	Blue	Blue	Blue
Thickness, mm.	0.92	5.03	2.59	5.7	5.64
Wave length, microns					
0.22	....	....	....	....	....
.24	....	....	....	....	....
.26	....	....	....	....	....
.28	....	....	....	....	....
.30	0	....	....	....	0
.32	.06	0	....	0	.04
.34	.43	.20	....	.06	.55
.36	.71	.58	0	.37	.76
.38	.80	.75	.07	.65	.81
.40	.84	.81	.20	.73	.82
.42	.84	.77	.24	.74	.79
.44	.82	.70	.16	.72	.73
.46	.78	.60	.06	.64	.58
.48	.73	.35	0	.40	.30
.50	.63	.14	....	.17	.09
.52	.49	.03	....	.05	.01
.54	.40	.01	....	.02	0
.56	.43	.02	....	.02	....
.58	.35	0	....	.01	....
.60	.26	....	....	0	....
.62	.25	....	....	....	....
.64	.22	....	....	....	....
.66	.26	0	....	0	0
.68	.37	.06	....	.01	.03
.70	.46	.47	....	.03	.38
.72	....	.72	....	....	....

TRANSMISSION OF ULTRA-VIOLET, VISIBLE AND INFRA-RED RADIATION BY VARIOUS NEUTRAL AND COLORED GLASSES (Continued).

SECTION I (Continued)

Designation...	G 55 D 70%	G 172 B W 5	G 554 CP	G 586 A	G 586 C
Maker.....	C. G. W.	C. G. W.	C. G. W.	C. G. W.	C. G. W.
Color.....	Blue	Purple	Purple	Purple	Purple
Thickness, mm.	0.97	5.27	5.48	1.03	4.05
Wave length, microns					
0.22	....	....	....	....	....
.24	....	....	....	....	....
.26	....	....	....	....	....
.28	0	....	....	0	....
.30	.05	....	....	.02	0
.32	.55	0	0	.35	.08
.34	.80	.19	.05	.78	.45
.36	.86	.55	.36	.90	.68
.38	.88	.71	.60	.88	.56
.40	.89	.70	.58	.73	.11
.42	.89	.50	.25	.25	0
.44	.89	.22	.17	.06	....
.46	.88	.08	.02	.02	....
.48	.86	.03	0	.02	....
.50	.82	.02	....	.02	....
.52	.72	.02	....	.03	....
.54	.68	.02	....	.03	....
.56	.73	.03	....	.03	....
.58	.66	.06	0	.04	....
.60	.60	.08	.01	.06	....
.62	.61	.12	.02	.03	....
.64	.61	.14	.04	.03	....
.66	.63	.17	.05	.06	....
.68	.76	.22	.06	.17	....
.70	.87	.26	.07	.42	....
.72	....	.31	....	....	....

TRANSMISSION OF ULTRA-VIOLET, VISIBLE AND INFRA-RED RADIATION BY VARIOUS NEUTRAL AND COLORED GLASSES (Continued)

SECTION II

EYE PROTECTIVE GLASSES FOR THE ULTRA-VIOLET AND VISIBLE

esignation....	Crookes A Wellsworth	Crookes B Wellsworth	Smoke A	Smoke B	Smoke C
aker.....	A. O. C.	A. O. C.	A. O. C.	A. O. C.	A. O. C.
olor.....	Neutral	Neutral	Neutral	Neutral	Neutral
hickness, mm.	2.05	2.16	2.10	2.14	2.13
Wave length, microns					
0.22	....	....	....	....	....
.24	....	....	....	....	....
.26	....	....	....	....	....
.28	....	....	....	....	....
.30	....	....	0	....	....
.32	....	....	.06	0	....
.34	0	0	.47	.09	0
.36	.15	.15	.74	.50	.38
.38	.72	.60	.84	.67	.61
.40	.82	.64	.85	.67	.62
.42	.84	.48	.80	.47	.37
.44	.86	.35	.74	.34	.22
.46	.86	.34	.73	.32	.20
.48	.87	.41	.75	.35	.23
.50	.91	.44	.76	.37	.24
.52	.87	.45	.75	.37	.25
.54	.88	.47	.75	.38	.26
.56	.90	.50	.76	.42	.29
.58	.76	.41	.76	.39	.26
.60	.84	.46	.74	.37	.25
.62	.90	.48	.75	.37	.25
.64	.92	.48	.75	.37	.25
.66	.92	.55	.76	.44	.32
.68	.92	.68	.82	.59	.50
.70	.92	.80	.87	.76	.70
.72	.91	....	....	....	....

TRANSMISSION OF ULTRA-VIOLET, VISIBLE AN INFRA-RED RADIATION BY VARIOUS NEUTRAL AND COLORED GLASSES (Continued)

SECTION II (Continued)

	Smoke	Amber	Amber	Luxfel	Noviol
Designation....	D	A	B	.....	AA
Maker.....	A. O. C.	A. O. C.	A. O. C.	A. O. C.	A. O. C.
Color.....	Neutral	Yellow	Yellow	Yellow	Yellow
Thickness, mm.	2.03	2.13	2.13	2.00	1.88
Wave length, microns					
0.22	....	....	....	....	....
.24	....	....	....	....	....
.26	....	....	....	....	....
.28	....	....	....	....	....
.30	....	....	....	....	....
.32	....	....	....	0	0
.34	0	0	....	.01	.01
.36	.02	.07	....	.32	.23
.38	.10	.21	0	.55	.44
.40	.23	.44	.07	.68	.57
.42	.12	.52	.12	.76	.68
.44	.07	.57	.17	.76	.75
.46	.06	.66	.25	.77	.81
.48	.08	.71	.34	.79	.84
.50	.09	.74	.42	.81	.87
.52	.09	.78	.49	.82	.88
.54	.10	.80	.55	.83	.89
.56	.12	.80	.60	.84	.89
.58	.10	.81	.64	.84	.89
.60	.07	.81	.66	.85	.89
.62	.08	.81	.67	.85	.89
.64	.08	.81	.68	.86	.88
.66	.13	.81	.69	.86	.88
.68	.28	.81	.70	.86	.87
.70	.54	.81	.71	.86	.86
.72	....	....	....	....	....

TRANSMISSION OF ULTRA-VIOLET, VISIBLE AND INFRA-RED RADIATION BY VARIOUS NEUTRAL AND COLORED GLASSES (Continued)

SECTION II (Continued)

	Noviol	Noviol	Noviol	Noviol	Noviol
Designation....	O	A	B	C	O
Maker.....	A. O. C.	A. O. C.	A. O. C.	A. O. C.	C. G. W.
Color.....	Yellow	Yellow	Yellow	Yellow	Yellow
Thickness, mm.	2.03	2.06	2.10	2.10	2.01
Wave length, microns					
0.22	....	....	....	....	....
.24	....	....	....	....	....
.26	....	....	....	....	....
.28	....	....	....	....	....
.30	....	....	....	....	....
.32	....	....	....	....	....
.34	....	....	....	....	....
.36	0	....	....	....	0
.38	.07	....	....	....	.08
.40	.35	0	....	....	.35
.42	.56	.01	....	....	.59
.44	.68	.55	0	....	.70
.46	.75	.73	.34	0	.77
.48	.80	.81	.73	.50	.82
.50	.83	.86	.83	.73	.84
.52	.85	.88	.86	.82	.86
.54	.86	.89	.88	.87	.87
.56	.87	.89	.89	.88	.87
.58	.87	.89	.89	.89	.87
.60	.86	.89	.89	.89	.87
.62	.86	.89	.88	.88	.87
.64	.86	.88	.88	.88	.86
.66	.85	.88	.88	.88	.87
.68	.85	.87	.88	.88	.88
.70	.84	.86	.88	.88	.88
.72	....	....	....	....	.88

TRANSMISSION OF ULTRA-VIOLET, VISIBLE AN INFRA-RED RADIATION BY VARIOUS NEUTRAL AND COLORED GLASSES (Continued)

SECTION II (Continued)

	Noviol	Noviol	Noviol	Saniweld	Saniwel
Designation....	A	B	C	Light	Dark
Maker.....	C. G. W.	C. G. W.	C. G. W.	K.	K.
Color.....	Yellow	Yellow	Yellow	Yellow	Yellow
Thickness, mm.	....	....	....	1.82	2.12
Wave length, microns					
0.22	....	....	....	....	....
.24	....	....	....	....	....
.23	....	....	....	....	....
.28	....	....	....	....	....
.30	....	....	....	....	....
.32	....	....	....	....	....
.34	....	....	....	....	....
.36	....	....	....	....	....
.38	....	....	....	....	....
.40	0	....	....	....	....
.42	.14	....	....	....	....
.44	.67	0	....	....	....
.46	.77	.49	0	....	....
.48	.82	.76	.26	....	....
.50	.84	.82	.78	0	0
.52	.86	.84	.84	.05	.003
.54	.87	.86	.86	.11	.011
.56	.87	.87	.87	.16	.018
.58	.87	.87	.87	.17	.022
.60	.87	.87	.87	.15	.018
.62	.87	.87	.87	.12	.016
.64	.86	.86	.86	.11	.016
.66	.87	.87	.87	.13	.020
.68	.88	.88	.88	.17	.027
.70	.88	.88	.88	.21	....
.72	.88	.88	.88	....	....

TRANSMISSION OF ULTRA-VIOLET, VISIBLE AND INFRA-RED RADIATION BY VARIOUS NEUTRAL AND COLORED GLASSES (Continued)

SECTION II (Continued)

	Rifleite	Fieuzal	Fieuzal	Fieuzal	Chloro-phile
Designation....	Dark	....	A	B	....
Maker.....	K.	W. & O.	A. O. C.	A. O. C.	W. & O.
Color.....	Yellow	Yellow green	Yellow green	Yellow green	Yellow green
Thickness, mm.	3.14	1.98	2.13	2.13	1.98
Wave length, microns					
0.22	....	....	....	....	....
.24	....	....	....	....	....
.26	....	....	....	....	....
.28	....	....	....	....	....
.30	....	....	....	....	....
.32	....	....	....	....	....
.34	....	0	0	....	0
.36	....	.14	.04	0	.06
.38	....	.35	.18	.03	.18
.40	....	.62	.36	.12	.35
.42	....	.65	.35	.15	.32
.44	....	.68	.37	.16	.32
.46	0	.72	.43	.21	.39
.48	.10	.78	.50	.28	.48
.50	.56	.82	.58	.38	.57
.52	.71	.84	.64	.47	.63
.54	.80	.86	.70	.64	.68
.56	.85	.86	.73	.57	.70
.58	.87	.85	.68	.55	.68
.60	.87	.84	.67	.55	.63
.62	.87	.83	.65	.53	.60
.64	.87	.84	.64	.53	.59
.66	.87	.84	.65	.55	.62
.68	.87	.84	.66	.58	.64
.70	.87	....	.67	.61	.68
.72	.86	....	....	....	....

TRANSMISSION OF ULTRA-VIOLET, VISIBLE AND INFRA-RED RADIATION BY VARIOUS NEUTRAL AND COLORED GLASSES (Continued)

SECTION II (Continued)

	Hallauer	A Kopos	Euphos	Blue	Blue
Designation....	....	....	....	A	B
Maker.....	W. & O.	K	A. O. C.	A. O. C.	A. O. C.
Color.....	Yellow green	Yellow green	Yellow green	Blue	Blue
Thickness, mm.	1.90	2.17	1.95	2.10	2.04
Wave length, microns					
0.22	....	....	....	....	....
.24	....	....	....	....	....
.26	....	....	....	....	....
.28	....	....	....	....	....
.30	....	....	....	0	0
.32	....	....	....	.33	.20
.34	....	....	....	.70	.65
.36	....	....	....	.84	.82
.38	....	....	....	.89	.87
.40	0	0	0	.91	.89
.42	.02	.01	.08	.92	.87
.44	.06	.04	.20	.92	.85
.46	.15	.11	.35	.91	.81
.48	.27	.19	.53	.90	.76
.50	.39	.28	.67	.89	.70
.52	.47	.36	.74	.87	.64
.54	.50	.39	.77	.87	.63
.56	.52	.40	.78	.89	.68
.58	.53	.41	.76	.87	.58
.60	.50	.38	.72	.86	.53
.62	.47	.34	.68	.86	.56
.64	.47	.34	.66	.86	.55
.66	.53	.41	.67	.87	.58
.68	.61	.52	.69	.88	.68
.70	.69	.62	.72	.89	.87
.72	....	.67	....	....	....

TRANSMISSION OF ULTRA-VIOLET, VISIBLE AND INFRA-RED RADIATION BY VARIOUS NEUTRAL AND COLORED GLASSES (Continued)

SECTION II (Continued)

	Blue	Blue	Cobalt blue	Cobalt blue	Cobalt blue
Designation....	C	D	AA	B	D
Maker.....	A. O. C.	A. O. C.	A. O. C.	A. O. C.	A. O. C.
Color.....	Blue	Blue	Blue	Blue	Blue
Thickness, mm.	2.05	2.11	2.75	1.85	1.86
Wave length, microns					
0.22	....	....	....	....	....
.24	....	....	....	....	....
.26	....	....	....	....	....
.28	....	....	....	....	....
.30	0	....	....	0	0
.32	.20	0	0	.07	.18
.34	.65	.36	.26	.52	.64
.36	.80	.69	.67	.82	.82
.38	.85	.78	.74	.87	.82
.40	.87	.76	.74	.83	.70
.42	.85	.65	.70	.68	.50
.44	.81	.54	.60	.43	.30
.46	.73	.40	.41	.26	.09
.48	.63	.27	.21	.02	0
.50	.48	.13	.07	0	....
.52	.37	.04	.02	....	....
.54	.35	.04	.01	....	....
.56	.42	.09	.04	....	....
.58	.28	.03	0	....	....
.60	.23	.01	....	....	....
.62	.26	.02	....	....	....
.64	.24	.01	....	....	....
.66	.28	.03	0	....	....
.68	.46	.12	.05	0	0
.70	.76	.43	.33	.08	.04
.72	....	....	.58	.32	.40

TRANSMISSION OF ULTRA-VIOLET, VISIBLE AND INFRA-RED RADIATION BY VARIOUS NEUTRAL AND COLORED GLASSES (Continued)

SECTION II (Continued)

	Amethyst	Amethyst	Pfund	Noviweld	Noviweld
Designation....	A	C	Gold film	4	5
Maker.....	A. O. C.	A. O. C.	....	A. O. C.	A. O. C.
Color.....	Purple	Purple	....	Yellow	Yellow
Thickness, mm.	2.08	2.04	2.89*	1.89	2.16
Wave length, microns					
0.22	....	....	....	....	....
.24	....	....	....	....	....
.26	....	....	....	....	....
.28	....	....	....	....	....
.30	....	....	....	....	....
.32	....	....	....	....	....
.34	0	0	....	....	....
.36	.47	.47	0	....	....
.38	.80	.77	.02	....	....
.40	.86	.80	.03	....	....
.42	.82	.72	.04	....	....
.44	.77	.63	.05	....	....
.46	.73	.56	.06	....	....
.48	.70	.51	.07	....	....
.50	.70	.48	.08	....	....
.52	.71	.48	.07	0	0
.54	.74	.51	.06	.02	.01
.56	.75	.54	.04	.04	.02
.58	.75	.56	.03	.05	.02
.60	.76	.63	.03	.05	.02
.62	.78	.65	.03	.04	.02
.64	.79	.67	.03	.04	.02
.66	.80	.69	.02	.06	.02
.68	.81	.72	....	.06	.02
.70	.81	.74	....	.06	.02
.72	....	....	....	....	....

TRANSMISSION OF ULTRA-VIOLET, VISIBLE AND INFRA-RED RADIATION BY VARIOUS NEUTRAL AND COLORED GLASSES (Continued)

SECTION II (Continued)

	Special Noviweld	391	Welding glass	Welders	Special Welders
Designation	No. 8	D D	5	Smoke dark	Light
Maker	H	C. G. W.	C. E. S.	A. O. C.	A. O. C.
Color	Yellow	Red	Red	Neutral	Green
Thickness, mm.	1.77	1.87	1.87	1.42	1.68
Wave length, microns					
0.22	....	....	.....	....	....
.24	....	....	....	....	....
.26	....	....	....	....	....
.28	....	....	....	....	....
.30	....	....	....	....	....
.32	....	....	....	....	....
.34	.....	....	.....	0	....
.36	.....	.....	....	.13	0
.38	....	0	....	.24	.02
.40	.....	0	.....	.33	.05
.42	.....	0	.....	.12	.02
.44	.....	0	....	.04	0
.46	.....	0	....	.02	0
.48	.....	0	....	.02	0
.50	....	0	.....	.03	.01
.52	0	0	....	.05	.01
.54	.008	.004	0	.06	.02
.56	.021	.012	.01	.07	.02
.58	.032	.019	.03	.07	.01
.60	.034	.023	.06	.06	.01
.62	.032	.024	.08	.05	0
.64	.034	.026	.10	.04	...
.66	.037	.....	.12	.05	....
.68	....	...	.....	....	...
.70	.....	....	....	....	....
.72	....	....	....	.....	....

TRANSMISSION OF ULTRA-VIOLET, VISIBLE AND INFRA-RED RADIATION BY VARIOUS NEUTRAL AND COLORED GLASSES (Continued)

SECTION II (Continued)

	Welding glass	Welding glass	124 I P	Welding glass	Welding glass
Designation....	6	2	....	3	1
Maker.....	C. E. S	C. E. S.	C. G. W.	C. E. S.	C. E. S.
Color.....	Yellow	Yellow	....	....	....
Thickness, mm.	1.97	2.32	2.00	1.48	1.98
Wave length, microns					
0.22	....	....	....	....	....
.24	....	....	....	....	....
.26	....	....	....	....	....
.28	....	....	....	....	....
.30	....	....	....	....	....
.32	....	....	....	....	....
.34	....	....	....	....	....
.36	....	....	....	....	....
.38	....	....	....	....	....
.40	....	....	0	....	....
.42	....	....	.001	....	....
.44	....	....	.003	....	....
.46	0	....	.008	....	....
.48	.01	....	.011	....	....
.50	.02	0	.014	....	....
.52	.03	.02	.016	0	0
.54	.05	.03	.017	.005	.002
.56	.07	.05	.017	.015	.006
.58	.09	.05	.017	.013	.005
.60	.11	.05	.015	.007	.004
.62	.12	.04	.013	.004	.005
.64	.13	.04	.011	....	.005
.66	.15	.05	.010	....	.010
.68	.18	.06	....	....	.030
.70	.22	.06	....	....	.073
.72	....	....	....	....	....

TRANSMISSION OF ULTRA-VIOLET, VISIBLE AND INFRA-RED RADIATION BY VARIOUS NEUTRAL AND COLORED GLASSES (Continued)

SECTION III

EYE PROTECTIVE GLASSES IN THE INFRA RED

	G 55 A	G 585	Amethyst	Blue-green	Blue-green
Designation....	62	....	C	G 124-J	G 124 J A
Maker.....	C. G. W.	C. G. W.	A. O. C.	C. G. W.	C. G. W.
Color.....	Purple	Blue-purple	Purple	Blue-green	Blue-green
Thickness, mm.	2.85	3.13	1.92	2.60	1.50
Wave length, microns					
1.0	.14	.70	.89	.03	0
1.5	.25	.08	.91	.05	.02
2.0	.10	.26	.90	.13	.05
2.5	.12	.61	.87	.19	.10
3.0	.15	.23	.47	.12	.11
3.5	.08	.16	.28	.04	.13
4.0	.10	.21	.29	.06	.18
4.5	.02	.02	.05	0	.06
5.0	0	0	0	....	0

	Blue-green	"Gold glass"*	Electric	New noviweld	New noviweld
Designation....	No. 59	....	Smoke	Shade 3	Shade 6
Maker.....	A. O. C.	....	....	C. G. W.	C. G. W.
Color.....	Blue-green	....	Red	....	....
Thickness, mm.	1.93	....	2.52	2.20	2.2
Wave length, microns					
1.0	0	.03	.03	.01	0
1.5	0	.02	.22	.02	0
2.0	.02	.02	.35	.05	.02
2.5	.06	.01	.39	.13	.04
3.0	.07	.01	.11	.05	.02
3.5	.08	0	.09	.07	.03
4.0	.12	....	.13	.07	.04
4.5	.03	....	.02	.01	0
5.0	0	....	0	0	....

* Gold film between two sheets of Crookes dark glass.

TRANSMISSION OF ULTRA-VIOLET, VISIBLE AND INFRA-RED RADIATION BY VARIOUS NEUTRAL AND COLORED GLASSES (Continued)

SECTION III (Continued)

	Euphos	Crookes	Crookes	Crookes	Crown
Designation....	Shade B	Light	Dark	Ferrous	....
Maker.....	B. & L.	A. O. C.	A. O. C.	A. O. C.	A. O. C.
Color.....	....	Neutral	Neutral	Sage-green	Neutral
Thickness, mm.	3.1	1 96	2.00	1.98	2.18
Wave length, microns					
1.0	.88	.93	.81	0	....
1.5	.90	.92	.80	.01	.92
2.0	.89	.90	.76	.05	.91
2.5	.86	.84	.77	.11	.86
3.0	.33	.38	.38	.07	.43
3.5	.18	.24	.27	.08	.30
4.0	.21	.27	.32	.12	.34
4.5	.02	.07(?)	.09(?)	.03	.06
5.0	0	....	....	....	....

	Noviol	Noviol	Noviol	Fieuzal	Hallauer
Designation....	Yellow	Orange	Canary	Shade B	....
Maker.....	C. G. W.	C. G. W.	C. G. W.	A. O. C.	....
Color.....	Yellow	Orange	Yellow	Greenish yellow	Yellow green
Thickness, mm.	2.05	2.03	1.85	2.04	1.41
Wave length, microns					
1.0	.77	.80	.84	.76	.47
1.5	.80	.83	.86	.80	.62
2.0	.85	.86	.87	.84	.70
2.5	.84	.84	.83	.82	.75
3.0	.40	.45	.21	.29	.56
3.5	.25	.29	.24	.20	.54
4.0	.31	.36	.39	.28	.55
4.5	.12	.10	.27	.03	.20
5.0	0	0	.02	0	0

TRANSMISSION OF ULTRA-VIOLET, VISIBLE AND INFRA-RED RADIATION BY VARIOUS NEUTRAL AND COLORED GLASSES (Continued)

Section IV

Jena Glasses for the Ultra-violet, Visible and Infra-red

	Deep violet	Deep violet	Cobalt blue	Blue	Blue uviol
Designation....	U G 1	U G 2	B G 1	B G 2	B G 3
Thickness, mm.	1.00	1.00	1.00	1.00	1.00
Wave length, microns					
.281	0	0	.04	0	.14
.302	.17	.08	.40	.02	.68
.312	.37	.47	.64	.13	.82
.334	.69	.79	.93	.41	.93
.366	.85	.87	.97	.76	.96
.405	.08	.03	.97	.74	.91
.436	....	....	.86	.52	.66
.480	....	....	.44	.06	.15
.509	....	....	.14	.02	.01
.546	....	....	.04	.02	0
.578	....	....	.05	0	....
.644	0	0	.01	0	0
.700	.01	.12	.51	.32	.06
.775	.34	.30	.94	.84	.90
.85	.22	.19	.97	.83	.98
.95	.11	.12	.93	.74	.94
1.05	.07	.09	.86	.61	.81
1.15	.05	.07	.76	.50	.64
1.30	.04	.06	.58	.41	.39
1.45	.04	.06	.45	.38	.27
1.60	.03	.06	.40	.37	.19
1.80	.04	.06	.44	.38	.20
2.00	.04	.06	.50	.41	.28
2.40	.11	.11	.69	.51	.47
3.00	.17	.19	.55	.35	.49

TRANSMISSION OF ULTRA-VIOLET, VISIBLE AND INFRA-RED RADIATION BY VARIOUS NEUTRAL AND COLORED GLASSES (Continued)

SECTION IV (Continued)

	Pure blue	Dark blue	Filter blue	Copper blue	Bright blue
Designation....	B G 4	B G 5	B G 6	B G 7	B G 8
Thickness, mm.	1.00	1.00	1.00	1.00	1.00
Wave length, microns					
.281	....	....	....	....	....
.302	....	....	....	....	....
.312	0	....	....	0	0
.334	.04	0	0	.02	.23
.366	.74	.08	.07	.26	.75
.405	.88	.39	.37	.51	.94
.436	.87	.50	.46	.70	.98
.480	.53	.41	.34	.79	.97
.509	.16	.22	.13	.73	.96
.546	.01	.08	.03	.50	.91
.578	.01	.05	.01	.26	.84
.644	0	.02	.01	.03	.57
.700	.07	.13	.13	0	.42
.775	.13	.13	.14	0	.34
.85	.12	.10	.10	.01	.32
.95	.11	.12	.12	.02	.36
1.05	.12	.15	.15	.04	.44
1.15	.13	.19	.18	.08	.51
1.30	.12	.24	.23	.15	.60
1.45	.11	.29	.27	.24	.68
1.60	.14	.34	.31	.35	.75
1.80	.21	.42	.38	.48	.82
2.00	.31	.49	.46	.58	.86
2.40	.59	.68	.66	.74	.89
3.00	.40	.37	.36	.56	.56

TRANSMISSION OF ULTRA-VIOLET, VISIBLE AND INFRA-RED RADIATION BY VARIOUS NEUTRAL AND COLORED GLASSES (Continued)

SECTION IV (Continued)

	Bright blue	Bright blue	Blue Didymium	Yellow-green	Filter green
Designation....	B G 9	B G 10	B G 11	V G 1	V G 2
Thickness, mm.	1.00	1.00	1.00	1.00	1.00
Wave length, microns					
.281	....	....	....	....	....
.302	0	....	0	....	....
.312	.01	0	.38	....	....
.334	.21	.14	.82	....	....
.366	.67	.64	.95	....	....
.405	.90	.85	.97	0	0
.436	.94	.93	.96	.02	.03
.480	.96	.95	.93	.47	.39
.509	.96	.96	.95	.75	.66
.546	.95	.94	.99	.77	.65
.578	.93	.88	.70	.56	.46
.644	.86	.75	1.00	.12	.15
.700	.74	.62	.99	.06	.09
.775	.56	.42	.90	.04	.07
.85	.46	.31	.92	.05	.06
.95	.38	.25	.98	.09	.09
1.05	.34	.24	.99	.13	.13
1.15	.33	.26	.99	.18	.18
1.30	.36	.31	.98	.27	.27
1.45	.42	.39	.97	.37	.37
1.60	.49	.47	.96	.47	.47
1.80	.56	.53	.97	.57	.57
2.00	.59	.55	.97	.65	.65
2.40	.64	.58	.93	.76	.75
3.00	.50	.46	.54	.55	.54

TRANSMISSION OF ULTRA-VIOLET, VISIBLE AND INFRA-RED RADIATION BY VARIOUS NEUTRAL AND COLORED GLASSES (Continued)

SECTION IV (Continued)

	Green-band absorption	Colorless	Colorless	Light yellow	Light greenish yellow
Designation....	V G 3	G G 1	G G 2	G G 3	G G 4
Thickness, mm.	1.00	1.00	1.00	1.00	1.00
Wave length, microns					
.281	....	....	....	0	....
.302	....	.02	....	.03	....
.312	0	.13	....	.05	0
.334	.01	.47	0	.09	.03
.366	.37	.86	.64	.16	.01
.405	.33	.98	.97	.21	.40
.436	.06	.99	.99	.85	.67
.480	.02	1.00	1.00	.99	.92
.509	.64	1.00	1.00	1.00	.95
.546	.20	1.00	1.00	1.00	.97
.578	.65	1.00	1.00	1.00	.96
.644	0	1.00	1.00	1.00	.94
.700	.85	1.00	1.00	1.00	.96
.775	.59	1.00	1.00	.99	.99
.85	.32	1.00	1.00	.98	.99
.95	.36	1.00	1.00	.98	.99
1.05	.22	1.00	1.00	.97	.99
1.15	.20	1.00	1.00	.97	.99
1.30	.39	1.00	1.00	.97	.99
1.45	.34	1.00	1.00	.98	.99
1.60	.22	1.00	1.00	.98	.99
1.80	.38	1.00	1.00	.98	.99
2.00	.47	1.00	.99	.98	.99
2.40	.30	.96	.98	.96	.98
3.00	.12	.50	.70	.62	.64

TRANSMISSION OF ULTRA-VIOLET, VISIBLE AND INFRA-RED RADIATION BY VARIOUS NEUTRAL AND COLORED GLASSES (Continued)

SECTION IV (Continued)

	Bright yellow	Med. yellow	Med. yellow	Bright greenish yellow	Greenish yellow
Designation....	G G 5	G G 6	G G 7	G G 8	G G 9
Thickness, mm.	1.00	1.00	1.00	1.00	1.00
Wave length, microns					
.281	0	0	....	....	0
.302	.01	.02	0	....	.01
.312	.02	.05	.01	....	.01
.334	.03	.11	.04	....	0
.366	.09	.14	.05	0	0
.405	.14	.21	.12	.05	.01
.436	.40	.36	.16	.26	.14
.480	.99	.73	.65	.75	.78
.509	1.00	.98	.99	.88	.88
.546	1.00	1.00	.99	.99	.93
.578	1.00	1.00	1.00	.99	.92
.644	1.00	1.00	1.00	.92	.89
.700	1.00	.99	1.00	.92	.91
.775	.99	.98	.99	.98	.95
.85	.99	.97	.99	.98	.98
.95	.98	.96	.98	.99	.99
1.05	.98	.95	.98	1.00	.99
1.15	.98	.95	.97	1.00	.99
1.30	.97	.95	.96	1.00	.99
1.45	.97	.96	.96	1.00	.99
1.60	.98	.96	.97	1.00	.99
1.80	.98	.97	.98	.99	.99
2.00	.98	.97	.98	.99	.99
2.40	.97	.94	.95	.96	.97
3.00	.62	.62	.65	.68	.69

TRANSMISSION OF ULTRA-VIOLET, VISIBLE AND INFRA-RED RADIATION BY VARIOUS NEUTRAL AND COLORED GLASSES (Continued)

SECTION IV (Continued)

	Dark greenish yellow	Dark yellow	Fluor-escent yellow	Yellow-orange	Pure orange
Designation....	G G 10	G G 11	G G 12	O G 1	O G 2
Thickness, mm.	1.00	1.00	1.00	1.00	1.00
Wave length, microns					
.281	....	....	....	....	....
.302	....	....	....	....	....
.312	....	....	0	....	....
.334	....	....	.03	....	....
.366	....	....	.74	....	....
.405	0	0	.53	....	....
.436	.09	.01	.71	....	....
.480	.59	.24	.90	0	....
.509	.85	.97	.96	.01	....
.546	.97	.99	.99	.96	.05
.578	.95	.99	1.00	1.00	.86
.644	.83	.99	1.00	1.00	1.00
.700	.86	.99	1.00	1.00	1.00
.775	.96	.98	1.00	.99	.99
.85	.99	.97	1.00	.99	.99
.95	.99	.96	1.00	.98	.98
1.05	.99	.96	1.00	.98	.98
1.15	1.00	.96	1.00	.98	.98
1.30	1.00	.96	1.00	.98	.98
1.45	.99	.96	1.00	.98	.98
1.60	.99	.96	.99	.98	.98
1.80	.99	.97	.99	.98	.98
2.00	.99	.97	.99	.98	.98
2.40	.94	.95	.98	.96	.95
3.00	.44	.66	.67	.62	.63

TRANSMISSION OF ULTRA-VIOLET, VISIBLE AND INFRA-RED RADIATION BY VARIOUS NEUTRAL AND COLORED GLASSES (Continued)

SECTION IV (Continued)

	Reddish orange	Bright red	Pure red	Dark red	Dark red
Designation....	O G 3	R G 1	R G 2	R G 3	R G 4
Thickness, mm.	1.00	1.00	1.00	1.00	1.00
Wave length, microns					
.281	....	....	....	....	....
.302	....	....	....	....	....
.312	....	....	....	....	....
.334	....	....	....	....	....
.366	....	....	....	....	....
.405	....	....	....	....	....
.436	....	....	....	....	....
.480	....	....	....	....	0
.509	....	....	....	....	.02
.546	0	....	....	....	.05
.578	.48	0	0	0	.10
.644	1.00	.96	.92	.54	.55
.700	1.00	.98	.98	.70	.73
.775	.99	.98	.98	.81	.82
.85	.99	.98	.98	.88	.87
.95	.98	.98	.98	.92	.91
1.05	.98	.98	.98	.94	.93
1.15	.98	.98	.98	.95	.94
1.30	.98	.98	.98	.97	.96
1.45	.98	.98	.98	.97	.97
1.60	.98	.98	.98	.98	.98
1.80	.98	.98	.98	.98	.98
2.00	.99	.98	.98	.98	.99
2.40	.97	.96	.95	.94	.97
3.00	.63	.65	.65	.56	.67

TRANSMISSION OF ULTRA-VIOLET, VISIBLE AND INFRA-RED RADIATION BY VARIOUS NEUTRAL AND COLORED GLASSES (Continued)

SECTION IV (Continued)

	Dark red	Black	Black	Dark neutral	Med. neutral	Light neutral
Designation.....	R G 5	N G 1	N G 2	N G 3	N G 4	N G 5
Thickness, mm..	1.00	0.1	0.1	1.00	1.00	1.00
Wave length, microns						
.281	....	....	.04	....	....	....
.302	....	....	.17	....	....	....
.312	....	....	.23	....	....	....
.334	....	0	.39	....	0	0
.366	....	.21	.46	0	.02	.29
.405	....	.29	.55	.04	.17	.54
.436	....	.32	.58	.07	.21	.59
.480	....	.36	.57	.09	.28	.63
.509	....	.36	.58	.10	.30	.65
.546	....	.36	.61	.11	.29	.66
.578	0	.36	.60	.12	.31	.68
.644	.02	.37	.64	.14	.36	.70
.700	.96	.45	.77	.18	.42	.70
.775	.98	.50	.80	.24	.42	.65
.85	.98	.49	.80	.24	.42	.61
.95	.98	.48	.81	.24	.41	.59
1.05	.98	.50	.85	.25	.41	.59
1.15	.99	.54	.85	.29	.44	.61
1.30	.99	.59	.86	.34	.50	.65
1.45	.99	.63	.88	.40	.55	.70
1.60	.99	.67	.89	.47	.59	.73
1.80	.99	.71	.90	.52	.63	.76
2.00	.99	.73	.91	.54	.66	.78
2.40	.97	.78	.93	.58	.67	.76
3.00	.58	.72	.87	.26	.23	.40

TRANSMISSIBILITY FOR RADIATIONS

Ratio of the transmitted light to the incident light for a definite thickness of the substance, usually 1 cm.

Glass.

Glass in general is opaque to the ultra-violet and infra-red. Uviol glass is transparent to the longer radiations of the ultra-violet.

Coefficient of transparency of glass for visible and ultra-violet radiations.

	Normal incidence, thickness 1 cm.								
Wave length microns.....	0.309	0.330	0.347	0.357	0.361	0.375	0.384	0.388	0.396
Crown, ordinary..	...	[illegible]	...	...	[illegible]	.947			
Crown, borosilicate.....	0.08	0.65	0.88	...	0.95	...	0.972	0.975	0.986
Flint, ordinary...	...	[illegible]	...	0.72	[illegible]	...	...	0.904	
Flint, heavy.....	...	[illegible]	0.01	...	0.16	...	0.58		

	Normal incidence, thickness 1 cm.								
Wave length, microns.....	0.400	0.415	0.419	0.425	0.434	0.455	0.500	0.580	0.677
Crown, ordinary..	0.964	...	0.952	...	0.960	0.981	...	0.986	0.990
Crown, borosilicate.....	...	0.985	...	0.993	...	...	0.993		
Flint, ordinary...	...	0.959	...	...	...	...	1.00		
Flint, heavy.....	...	...	...	0.905					

See also pp. 175 and 176.

Quartz

Quartz is very transparent to the ultra-violet and to the visible spectrum, but opaque for the infra-red beyond 7.0μ.

(Pflüger.)

Wave length, microns.....	0.19	0.20	0.21	0.22
Transmission for 1 mm.....	.67	.84	.92	.94

Fluorite

Fluorite is very transparent to the ultra-violet, nearly to 0.10μ. Coefficient of transparency at $\lambda = 186$ is found by Pflüger to be 0.80.

For the infra-red the values are given in a table below.

TRANSMISSIBILITY FOR RADIATIONS (Continued)

Rock Salt and Sylvine and Fluorite

Transparency for the Infra-red.

Thickness 1 cm.

Wave length, microns.	Rock salt.	Sylvine KCl.	Fluorite.
8.	.....	.....	.844
9.	0.995	1.000	.543
10.	.995	.988	.164
12.	.993	.995	.010
14.	.931	.975	.000
16.	.661	.936	
18.	.275	.862	
19.	.096	.758	
20.7	.006	.585	
23.7	.000	.155	

PHOSPHORESCENCE BY CATHODE RAYS

Substances Luminous under Excitation by Cathode Rays

Substance (with calcium oxide).	Wave lengths of principal bands in microns (Urbain, 1909.)
Dysprosium oxide.....	0.480, 0.489, 0.585, 0.675
Europium oxide.....	0.416–0.426, 0.469
Europium oxide.....	0.589–0.593, 0.613, 0.625
Neodymium oxide.....	0.392, 0.419–0.429, 0.458
Praesodymium oxide.....	0.488, 0.604, 0.606, 0.626, 0.634

One part.	100 parts.	Wave length.	Color.	Observer.
Antimony oxide..	calcium oxide	0.560	yellow	Bruninghaus, 1910
Antimony trisulphide.....	calcium sulphide	0.569	yellow	Bruninghaus, 1910
Bismuth oxide...	calcium oxide	0.522	blue	Bruninghaus, 1910
Bismuth sulphate.	calcium sulphate	0.640	red	Bruninghaus, 1910
Manganous carbonate.....	magnesium carbonate	0.620	red	Bruninghaus, 1910
oxide.....	calcium oxide	0.589	yellow	Lecoq & Boisbaudran 1886
phosphate.....	calcium phosphate $Ca_3(PO_4)_2$	0.633	red	Bruninghaus, 1910
sulphate.....	calcium sulphate	0.540	green	Lecoq & Boisbaudran 1886
sulphide.....	calcium sulphide	0.589	yellow	Bruninghaus, 1910

FLUORESCENCE OF ORGANIC SUBSTANCES IN SOLUTION

Excitation by White Light.

Substance.	Solvent.	Wave length microns.	Observer.
Anthracene.....	alcohol	0.400 0.430 0.436	Stark & Meyer, 1907
Eosine.....	alcohol or water	0.589	Nichols & Merritt, 1907
Esculine.....	alcohol	0.460	Nichols & Merritt, 1907
Fluorescein.....	water (alkaline)	0.542	Nichols & Merritt, 1907
Naphthalin, red..	alcohol	0.632	Nichols & Merritt, 1907
Quinine sulphate.	water	0.437	Nichols & Merritt, 1907
Resorcin blue....	water	0.65	Nichols & Merritt, 1907
Rhodamin.....	water	0.554	Nichols & Merritt, 1907

FLUORESCENCE

Gases and Vapors.

Gas or vapor.	Condition.	Excitation.	Color or wave length of emitted light.	Observer.
Iodine...	Vapor at ordinary temperature.	Mercury arc $\lambda = .546\mu$	Strongest bands $\lambda = .5460\mu, .5774\mu$ .5730, .5796	Wood, 1911
Mercury .	Vapor at ordinary temperature	Spark between aluminum electrodes	Broad band $\lambda = .5900–.3000$	Wood, 1909
Oxygen ..	.....	Mercury arc in quartz tube	Strongest lines $\lambda = .1849, .1851$ (ultra-violet)	Streubing, 1910
Potassium	Vapor, 300°–400° C.	White light	Many strong lines from .6416–.6768, strongest .6544 and .6584	Wood & Carter, 1908
Rubidium	Vapor, at 270° C.	White light (elec. arc)	Strong red band $\lambda = .6900–.6620.$	Dunoyer, 1912
Sodium ..	Vapor at 350° C.	White light (elec. arc)	D, $\lambda = .5893$ (mean)	Dunoyer, 1912

SPECIFIC ROTATION

The tables give the specific rotation in degrees for one decimeter; + signifies right-handed rotation, − left. Rotation is for sodium light.

Liquids

Liquid.	Temp. °C.	Specific Rotation. Degrees.	Observer.
Amyl alcohol	....	−5.7	Le Bel
Camphor	204	+70.33	Gernez
Cedar oil	15	−30 to −40	
Citron oil	15	+62	
Menthol	35.2	−49.7	Paterson & Taylor
Nicotine	22.7	+150.0	Molby
Oil of turpentine	15	−20 to −40	

Solutions

Giving the rotation for one decimeter, for one gram of active substance in one cubic centimeter of solution.

Active substance.	Solvent.	Temp. °C.	Spec. rot.	Observer.
Albumen, egg	water	....	−25 to −38	
Camphor	ether	....	+57.	Darmois, 1910
Dextrose (β)	water	15	+52.5	Tanret, 1896
Glucose (β)	water	20	+51.4	
Lactose	water	15	56.	
Maltose	water	20	+136.9	
Quinine sulphate	alcohol	17	−57.5	Oudemans, 1876
Sugar cane	water	20	66.5	
Tartaric acid	water	20	+13.44	Wendel, 1898

Solids

(Rotation per millimeter.)

Substance.	Rotation.	Substance.	Rotation.
Cinnabar (HgS)	32.5	Quartz	21.7
Lead hyposulphate	5.5	Sodium bromate	2.8
Potassium "	8.4	Sodium chlorate	3.13

MAGNETO OPTIC ROTATION

Verdet's Constant: $\rho = \dfrac{\alpha}{tH \cos \theta}$

The specific power of magnetic rotation ρ, is expressed in the above formula, where α is the total angle of rotation in minutes, t the thickness of the substance in centimeters, H the magnetic field intensity in gausses and θ the angle between the direction of the magnetic field and the path of light.

Solids

For sodium light.
(Values from the Smithsonian Tables.)

Substance.	Temp. ° C.	Verdet's Constant, Minutes.	Observer.
Amber	18–20	0.0095	Quincke
Blende	15	0.2234	Becquerel
Diamond	15	0.0127	Becquerel
Fluorspar	15	0.0087	Becquerel
Glass, crown	15	0.0203	Becquerel
flint	18–20	0.0420	Quincke
flint, dense	15	0.0647	Becquerel
Quartz ($\perp$ to axis)	18–20	0.0172	Quincke
Rock salt	15	0.0355	Becquerel
Selenium	15	0.4625	Becquerel
Sylvine	15	0.0283	Becquerel

Liquids

For sodium light.

Substance.	Density g/cm.³	Temp. ° C.	Verdet's Constant, minutes.	Observer.
Acetone	0.7947	20	0.0113	Jahn
Acids: (see also solutions in water) acetic	1.0561	21	0.0105	Perkin
hydrochloric	1.2072	15	0.0224	Perkin
hydrobromic	1.7859	15	0.0343	Perkin
nitric	1.5190	13	0.0070	Perkin
sulphuric	.....	15	0.0121	Becquerel
sulphurous	.....	15	0.0153	Becquerel
Alcohols: amyl	.....	15	0.0131	Becquerel
ethyl	0.7929	18–20	0.0107	Quincke
methyl	0.7915	18–20	0.0094	Quincke
Benzine	0.8796	20	0.0297	Jahn
Carbon disulphide	1.2644	18–20	0.0441	Quincke
Chloroform	1.4	20	0.0164	Jahn
Phosphorus (melted)	.....	33	0.1316	Becquerel
Sulphur (melted)	.....	114	0.0803	Becquerel
Toluene	.....	28.4	0.0269	Becquerel
Water	.....	18–20	0.0130	Schönrock
Xylene	.....	15	0.0221	Becquerel
Zinc bichloride	.....	15	0.0437	Becquerel

MAGNETO OPTIC ROTATION (Continued)

Aqueous Solutions

For sodium light.

Salt.	Density, g/cm³.	Temp. ° C.	Verdet's constant, minutes.	Observer.
Acids: hydrochloric	1.1856	15	0.0219	Perkin
hydrochloric	1.1279	15	0.0193	Perkin
hydrochloric	1.0323	20	0.0150	Jahn
nitric	1.3560	20	0.0105	Perkin
Ammonia	0.8918	15	0.0153	Perkin
Bromides: barium	1.5399	20	0.0215	Jahn
potassium	1.1424	20	0.0163	Jahn
sodium	1.1351	20	0.0165	Jahn
Carbonate of potassium	1.1960	20	0.0140	Jahn
Carbonate of sodium	1.1006	20	0.0140	Jahn
Chlorides: barium	1.2897	20	0.0168	Jahn
cadmium	1.3179	20	0.0185	Jahn
calcium	1.1504	20	0.0165	Jahn
iron (ferrous)	1.4331	15	0.0025	Becquerel
iron (ferric)	1.6933	15	−0.2026	Becquerel
lithium	1.0619	20	0.0145	Jahn
mercury	1.0381	16	0.0137	Schönrock
potassium	1.6000	15	0.0163	Becquerel
sodium	1.2051	15	0.0180	Becquerel
zinc	1.2851	15	0.0196	Verdet
Bichromate of potassium	1.0786	15	0.0126	Verdet
Iodides: potassium	1.6743	15	0.0338	Becquerel
Sulphates: barium	1.1788	20	0.0134	Jahn
potassium	1.0475	20	0.0133	Jahn
sodium	1.0661	20	0.0135	Jahn

Gases

For sodium light.

Substance.	Pressure.	Temp. ° C.	Verdet's constant, minutes.	Observer.
Atmospheric air	atmos.	ordinary	6.83×10^{-6}	Becquerel
Carbon dioxide	atmos.	ordinary	13.00	Becquerel
Carbon disulphide	74 cms.	70°	23.49	Bichat
Ethylene	atmos.	ordinary	34.48	Becquerel
Nitrogen	atmos.	ordinary	6.92	Becquerel
Nitrous oxide	atmos.	ordinary	16.90	Becquerel
Oxygen	atmos.	ordinary	6.28	Becquerel
Sulphur dioxide	atmos.	ordinary	31.39	Becquerel
Sulphur dioxide	246 cms	20°	38.40	Bichat

MISCELLANEOUS TABLES

α RAYS

The α rays are thought to be positively charged particles, moving with a high velocity. They are only slightly deviable by a strong magnetic or electric field and have small penetrating power. The initial velocity has been found to be about 2×10^9 cms./s. The mass of each particle is 6.2×10^{-24} g. (Rutherford and Geiger, 1910.) The charge carried by each, as measured by the same authors, is 9.3×10^{-10} electro static units.

β RAYS

The β rays are similar to the cathode rays produced by an electric discharge in a vacuum tube. They are judged to be negatively charged particles moving with high velocity. They are much more penetrating than the α rays, and are strongly deviated by a magnetic or electric field. The velocity of the moving particle is in the neighborhood of that of light, about 2×10^{10} cm./s. The charge on each particle is approximately 4.7×10^{-10} electro static units.

γ RAYS

The γ rays are similar to the X rays and are not deviable by magnetic or electric fields. They are more penetrating than either the α or β rays, and are considered to be of the nature of wave pulses in the ether.

RÖNTGEN RAYS

Scale of Hardness

The "radiochrometer" of Benoist consists of a disk of silver 0.11 mm. thick, which is surrounded by 12 sectors of aluminum ranging in thickness from 1 to 12 millimeters. The sector which shows the same absorption as the central disk gives the degree of hardness according to Benoist. The relation of this to other scales is shown below.

Benoist	2	3	4	5	6	7	8
Wehnelt	1.8–2	5	6.5	7.5	8	9	10–11
Walter	2.0–3	4–5	5–6	6	6–7	7	7–8

The absorption of rays is very nearly proportional to the mass of substance penetrated.

IONIZATION DUE TO RÖNTGEN RAYS IN VARIOUS GASES

From Smithsonian Physical Tables

Gas	Relative ionization		Density
	Soft rays, Strutt	Hard rays, Eve	
Hydrogen	0.11	0.42	0.069
Air	1.00	1.00	1.00
Oxygen	1.39	.....	1.11
Carbon dioxide	1.60	.....	1.53
Cyanogen	1.05	.....	1.86
Sulphur dioxide	7.97	2.3	2.19
Chloroform	31.9	4.6	4.32
Methyl iodide	72.0	13.5	5.05
Carbon tetrachloride	45.3	4.9	5.31
Hydrogen sulphide	.....	0.9	1.18

GRATING SPACE IN CRYSTALS

Calcite	3.02904×10^{-8}cm.	Millikan
Potassium ferrocyanide	8.408	Siegbahn
Rock salt, plane parallel to face	2.81	Bragg
Calcium fluoride	5.455 (Cu radiation)	Gerlach
	5.478 (Ni radiation)	"
Mica	9.845 (1st order)	Davis, Terrill
	9.958 (7th order)	" "
Silicon	5.415 (Cu radiation)	Gerlach
	5.410 (Ni radiation)	"
Zinc blende	5.90 (Cu radiation)	"

MEAN ABSORPTION COEFFICIENTS

(From Smithsonian Physical Tables)

If I_0 be the intensity of a parallel beam of homogeneous radiation incident normally on a plate of absorbing material of thickness t, then $I = I_0 e^{-\lambda x}$ gives the intensity I at the depth x. Because of the great homogeneity of the secondary X-rays they were used in the determination of the following coefficients. The coefficients λ have been divided by the density d.

Radiator	Absorber C.	Mg.	Al.	Fe.	Ni.	Cu.	Zn.	Ag.	Sn.	Pt.	Au.
Cr	15.3	126.	136.	104.	129.	143.	170.	580.	714.	(517.)	(507.)
Fe	10.1	80.	88.	66.	84.	95.	112.	381.	472.	340.	367.
Co	80.0	64.	72.	67.	67.	75.	92.	314.	392.	281.	306.
Ni	6.6	52.	59.	314.	56.	62.	74.	262.	328.	236.	253.
Cu	5.2	41.	48.	268.	63.	53.	61.	214.	272.	194.	210.
Zn	4.3	35.	39.	221.	265.	56.	50.	175.	225.	162.	178.
As	2.5	19.	22.	134.	166.	176.	204.	105.	132.	106.	106.
Se	2.0	16.	19.	116.	141.	150.	175.	88.	112.	93.	100.
Ag	.4	2.2	2.5	17.	23.	24.	27.	13.	16.	56.	61.

THE ABSORPTION OF X-RAYS

If radiation in traversing a thin layer of substance is reduced in intensity by a constant fraction μ per centimeter of the substance traversed, the intensity of the radiation, after penetrating to a depth x, is

$$I = I_0 e^{-\mu x}$$

where I_0 is the intensity at the surface. The quantity μ is called the "absorption coefficient." Similarly μ/ρ, the "mass absorption coefficient," is the fraction of a beam 1 cm² cross section absorbed per gram of substance traversed; and μ/ν, the "atomic absorption coefficient," where ν is the number of atoms per cm³, is the fraction of such a beam absorbed by each atom of the substance.

Values due principally to Hewlett and Richtmyer, compiled by Compton, 1922.

MASS ABSORPTION COEFFICIENTS

μ/ρ

Å.U.	Li 3	C 6	N 7	O 8	Al 13		Fe 26	Cu 29	Mo 42	Ag 47	Pb 82	H_2O (H)	H_2O (R)
						.071	.068	.....	.....	.....	.076	.....	....
.025	....	....	....	.....	.162	←Duane→		32	.....	.....	.....	.....	.168
.100	....	.144	....	.....	(H)	(R)							
.125	....	.154	....	.146	.174	.181	.399	.46	1.35	.....	Hull 3.0	.161	.176
											Hull 1.57	.180	.185
.150	....	.163	.163	.163	.200	.198	.585	.79	1.96	.....	3.69	.195	.195
.175	....	.166	.171	.174	.236	.221	.820	1.13	2.83	3.69	2.55	.199	.204
.20	....	.173	.177	.183	.273	.259	1.06	1.56	4.02	6.00	4.60	.219	.229
.25	....	.187	.193	.207	.358	.370	1.88	2.77	7.42	11.4	8.48	.246	.261
.30	.172	.202	.224	.243	.517	.532	3.09	4.50	12.7	18.2	14.2	.283	.301
.35	.188	.219	.251	.289	.719	.764	4.77	6.95	19.1	27.2	22.6	.334	.354
.40	.208	.240	....	.336	.982	1.06	7.02	10.1	26.7	38.6	33.6	.491	....
.50	.245	.304	....	.488	1.86	1.92	13.86	18.8	48.6	11.5	60.6	.711	....
.60	.306	.394	....	.730	3.05	3.23	22.6	31.6	80.7	19.6	.....	1.023	....
.70	.403	.532	....	1.08	4.84	5.05	35.3	48.8	18.8	.....	.....	1.475	....
.80	....	.706	....	1.53	7.26	.....	50.7	.....	27.2	.....	.....	2.70	....
1.00	....	1.27	....	.....	13.80	.....	90.2	.....	53.	87.←Bragg			

X-RAY SPECTRA

From data by Siegbahn and his associates except as noted, compiled by Duane, Bulletin of the National Research Council, 1920.

Emission Wave-Lengths in the K Series

$\lambda \times 10^{-8}$ cm.

For Rock salt d = 2.814 $\times 10^{-8}$ cm., for calcite d = 3.028 $\times 10^{-8}$ cm.

Chemical Element	Atomic Number	α_2	α_1	α_3	α_4	β_1	γ
Sodium	11	.....	11.8836	11.8024	11.7814	11.591	.....
Magnesium	12	.....	9.8675	9.79940	9.78620	9.53450	.....
Aluminium	13	.....	8.31940	8.26460	8.25300	7.94050	.....
Silicon	14	.....	7.10917	7.06382	7.05372	6.73933	.....
Phosphorus	15	.....	6.14171	6.10219	6.09500	5.78513	.....
Sulphur	16	.....	5.36066	5.32833	5.32175	5.01913	.....
Chlorine	17	.....	4.71870	4.692		4.39450	.....
Potassium	19	3.738	3.73386	3.724		3.44638	.....
Calcium	20	3.359	3.35186	3.328		3.08297	3.06740
Scandium	21	3.032	3.02526	3.011		2.77366	2.755(5)
Titanium	22	2.746	2.742	2.729		2.50874	2.49367
Vanadium	23	2.502	2.498	.....	.....	2.27968	2.26537
Chromium	24	2.288	2.28517	.....	.....	2.08144	2.069
Manganese	25	2.097	2.093	.....	.....	1.902	1.892
Iron	26	1.932	1.93239	.....	.....	1.75397	1.736
Cobalt	27	1.785	1.78524	.....	.....	1.61715	1.606
Nickel	28	1.657	1.65467	.....	.....	1.49669	1.48403
Copper	29	1.543	1.53736	.....	.....	1.38887	1.382
Zinc	30	1.437	1.433	.....	.....	1.294	1.281
Gallium	31	1.34161	1.33785	.....	.....	1.20591	.....
Germanium	32	1.261	1.257	.....	.....	1.131	1.121
Arsenic	33	1.174	1.170	.....	.....	1.052	1.038
Selenium	34	1.109	1.104	.....	.....	0.993	.....
Bromine	35	1.040	1.035	.....	.....	0.929	0.914
Rubidium	37	0.926	0.922	.....	.....	0.825	0.813
Strontium	38	0.876	0.871	.....	.....	0.779	0.767
Yttrium	39	0.840	0.835	.....	.....	0.746	0.733
Zirconium	40	0.793	0.788	.....	.....	0.705	.....
Niobium	41	0.754	0.749	.....	.....	0.669	0.657
Molybdenum[1]	42	0.71212	0.70783	.....	.....	0.63110	0.6197
Ruthenium	44	.....	0.645	.....	.....	0.574	.....
Rhodium[1]	45	0.6164	0.6121	.....	.....	0.5453	0.5342
Palladium	46	0.590	0.586	.....	.....	0.521	.....
Silver	47	0.567	0.562	.....	.....	0.501	0.491
Cadmium	48	0.543	0.538	.....	.....	0.479	.....
Indium	49	0.515	0.510	.....	.....	0.453	0.440
Tin	50	0.490	0.487	.....	.....	0.432	.....
Antimony	51	0.472	0.468	.....	.....	0.416	0.408
Tellurium	52	.....	0.456	.....	.....	0.404	.....
Iodine	53	.....	0.437	.....	.....	0.388	.....
Caesium	55	0.402	0.398	.....	.....	0.352	.....
Barium	56	0.393	0.388	.....	.....	0.343	.....
Lanthanum	57	0.376	0.372	.....	.....	0.329	.....
Cerium	58	0.360	0.355	.....	.....	0.314	.....
Praseodymium	59	0.347	0.342	.....	.....	0.301	.....
Neodymium	60	0.335	0.330	.....	.....	0.292	.....
Tungsten[1]	74	0.21341	0.20860	.....	.....	0.18420	0.17901

[1] Duane

X-RAY SPECTRA (Continued)

Emission–Wave Lengths in the L Series

$\lambda \times 10^{-8}$ cm.

For Rock salt d = 2.814 $\times 10^{-8}$ cm., for calcite d = 3.028 $\times 10^{-8}$ cm.

Chemical Element	At. no.	l	α_2	α_1	α_3	η	β_4	β_1	β_2	β_3	β_5	γ_1	γ_2	γ_3	γ_4
Zine	30			12.346				9.449							
Arsenic	33			9.701				8.141							
Bromine	35			8.391	8.360			7.091							
Rubidium	37			7.335	7.305			6.639							
Strontium	38			6.879				6.227							
Yttrium	39			6.464	6.440			5.851				5.386			
Zirconium	40			6.083	6.057			5.493	5.317						
Niobium	41		5.731	5.724	5.709			5.175							
Molybdenum	42		5.410	5.403	5.381			4.61100				4.17282			
Ruthenium	44		4.853	4.83567	4.823			4.364				3.935			
Rhodium	45			4.587	4.577			4.137	3.904	4.030		3.716	3.597		
Palladium	46		4.374	4.358	4.352		4.071	3.926	3.698	3.823		3.514			
Silver	47		4.155	4.154	4.133		3.861	3.730	3.514	3.639		3.328			
Cadmium	48		3.959	3.947			3.676	3.547	3.354			3.155			
Indium	49		3.774	3.763				3.377	3.172	3.300		2.994	2.903	2.889	2.831
Tin	50		3.604	3.591			3.337	3.218	3.021	3.149		2.845	2.782		
Antimony	51		3.443	3.431			3.184	3.069	2.881	3.007		2.706			
Tellurium	52		3.299	3.281			3.044	2.930	2.750	2.873		2.577			
Iodine	53		3.155	3.141			2.911	2.677	2.514	2.629		2.359	2.234		
Caesium	55		2.899	2.885			2.668	2.562	2.407	2.520		2.236			
Barium	56		2.786	2.769			2.558	2.452	2.307	2.414		2.136			
Lanthanum	57		2.674	2.659			2.453	2.350	2.212	2.307		2.044	2.003		
Cerium	58		2.573	2.555			2.357								

X-RAY SPECTRA (Continued)

EMISSION WAVE-LENGTHS IN THE SERIES L (*Continued*)

Chemical Element	At. no.	l	α_2	α_1	α_3	η	β_4	β_1	β_2	β_3	β_5	γ_1	γ_2	γ_3	γ_4
Praseodymium	59	.....	2.472	2.457	.....	.....	.....	2.253	2.120	2.217	.....	1.956	1.937	1.933	.....
Neodymium	60	.....	2.379	2.364	.....	.....	2.167	2.167	2.036	2.128	.....	1.873	1.803	1.775	.....
Samarium	62	.....	2.210	2.200	.....	.....	.....	1.993	1.884	1.965	.....	1.725	1.659		.....
Europium	63	.....	2.131	2.121	.....	.....	1.923	1.918	1.810	1.888	.....	1.662	1.599	1.590	.....
Gadolinium	64	.....	2.054	2.043	.....	.....	1.851	1.844	1.744	1.811	.....	1.597	(1.562)	(1.558)	.....
Terbium	65	.....	1.983	1.973	.....	1.935	1.784	1.775	1.682	1.745	1.659	1.531	1.477	1.470	1.437
Dysprosium	66	.....	1.916	1.907	.....	.....	1.721	1.709	1.622	1.683	.....	1.470	1.422	1.418	.....
Holmium	67	.....	1.854	1.843	.....	.....	1.657	1.646	1.568	1.620	.....	1.415	1.369	1.365	.....
Erbium	68	.....	1.794	1.783	.....	1.725	1.599	1.586	1.514	1.560	.....	1.367	1.323	1.316	.....
Aldebaranium	70	1.892	1.681	1.670	.....	1.618	1.490	1.474	1.414	1.451	1.422	1.267	1.228	1.223	.....
Cassiopeium	71	1.834	1.629	1.619	.....	.....	1.437	1.421	1.368	1.399	.....	1.188	1.183	.....	.....
Tantalum	73	.....	1.528	1.518	.....	1.435	1.343	1.323	1.280	1.303	.....	1.135	1.101	1.097	.....
Tungsten	74	1.675	1.484	1.473	.....	1.4177	1.298	1.279	1.23191	1.260	1.2031	1.095	1.06584	1.059	1.026
Osmium	76	.....	1.398	1.388	.....	.....	1.214	1.194	1.167	1.176	.....	1.021	.....	.....	.....
Iridium	77	1.840	1.360	1.350	.....	.....	1.176	1.154	1.133	1.138	1.101	0.989	0.962	0.956	0.917
Platinum	78	1.499	1.323	1.313	.....	1.242	1.142	1.120	1.101	1.098	1.072	0.958	0.933	0.929	0.900
Gold	79	1.457	1.283	1.271	.....	1.197	1.102	1.080	1.065	1.059	1.035	0.922	0.898	0.894	0.869
Mercury	80	.....	1.251	1.240	.....	.....	.....	1.049	1.042	.....	.....	0.896	.....	.....	.....
Thallium	81	1.385	1.215	1.205	.....	1.124	1.036	1.012	1.006	0.998	0.977	0.864	0.844	0.840	0.808
Lead	82	1.348	1.186	1.175	.....	1.091	1.008	0.983	0.983	0.968	.....	0.842	0.820	0.816	0.792
Bismuth	83	1.317	1.153	1.144	.....	1.059	0.977	0.950	0.954	0.937	0.923	0.810	0.794	0.790	0.762
Pollonium	84	.....	.....	1.101	.....	.....	.....	0.920	.....	.....	.....	.....	.....	.....	.....
Radium	88	.....	.....	1.010	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Thorium	90	1.117	0.969	0.957	.....	.....	.....	0.766	0.797	0.758	.....	0.654	0.635		.....
Uranium	92	1.066	0.922	0.911	.....	.....	.....	0.720	0.756	0.710	.....	0.615	0.596		.....

X-RAY SPECTRA (Continued)

Emission Wave-Length in the M Series

$\lambda \times 10^8$ cm.

For rock salt d = 2.814 $\times 10^{-8}$ cm.

Chemical Element	Atomic Number	α	β	γ	δ	ϵ
Uranium	92	3.9014	3.7083	3.4714	2.943	2.813
Thorium	90	4.1292	3.9333	3.6565	3.127	3.006
Bismuth	83	5.1072	4.8993	4.5238	.....	.....
Lead	82	5.2751	5.0648	4.6637	.....	.....
Thallium	81	5.4499	5.2384	4.802	.....	.....
Gold	79	5.819	5.601	5.115	.....	.....
Platinum	78	6.035	5.818	5.295	.....	.....
Iridium	77	6.245	6.029	.....	.....	.....
Osmium	76	6.477	6.250	.....	.....	.....
Tungsten	74	6.976	6.749	6.091	.....	.....
Tantalum	73	7.237	7.012	.....	.....	.....
Lutecium	71	7.818	7.593	.....	.....	.....
Ytterbium	70	8.130	7.898	.....	.....	.....
Erhium	68	8.770	8.561	.....	.....	.....
Holmium	67	9.123	8.930	.....	.....	.....
Dysprosium	66	9.509	9.313	.....	.....	.....

ATOMIC ABSORPTION COEFFICIENTS

$$\frac{\mu}{\nu} = \frac{\mu}{\rho} \times \frac{W}{N}$$

The values are multiplied by 10^{23}

A.U.	H 1	Li 3	C 6	N 7	O 8	Al 13	Fe 26	Cu 29	Mo 42	Ag 47	Pb 82	H_2O (H)
.025	..	....	.....	....	.....	.317	.625	.....	.....	.....	2.60	.....
.100	..	....	.285	....	.....	.724	.....	3.3	.....	.....	.....	.....
.125	.04	....	.305	....	.385	.792	3.67	4.8	21.3	.....	103.	.478
.150	.05	....	.323	.376	.430	.889	5.38	8.3	31.0	.....	53.6	.534
.175	.06	....	.329	.395	.459	1.04	7.55	11.8	44.7	66.5	86.1	.578
.20	.05	....	.343	.409	.482	1.19	9.75	16.4	63.5	107.	157.	.591
.25	.05	....	.370	.446	.546	1.62	17.3	29.0	117.	203.	290.	.650
.30	.04	.197	.400	.518	.641	2.34	28.4	47.2	201.	323.	485.	.730
.35	.04	.215	.433	.580	.763	3.31	43.9	72.9	302.	483.	772.	.840
.40	.05	.238	.475	....	.886	4.56	64.5	106.	422.	686.	1150.	.992
.50	.08	.280	.602	....	1.29	8.44	127.	197.	769.	204.	2070.	1.458
.60	.09	.350	.780	....	1.92	14.0	208.	332.	1277.	348.	.....	2.11
.70	.10	.462	1.052	....	2.85	22.1	325.	512.	297.	.....	.....	3.04
.80	.17	....	1.40	....	4.03	32.4	466.	.....	430.	.....	.....	4.38
1.00	..	....	2.51	....	.....	61.6	830.	.....	838.	2000.	.....	8.01

X-RAY SPECTRA AND ATOMIC NUMBERS

(From Smithsonian Physical Tables)

Kaye has shown that an element excited by sufficiently rapid cathode rays emits characteristic Röntgen radiations. These have been analyzed and the wave lengths obtained by Moseley (Phil. Mag. 27, p. 703, 1914) using a crystal of potassium ferrocyanide as a grating. The "K" series of elements shows 2 lines α and β, the "L" series several. The wave lengths of the α and β lines of each series are given in the following table. $Q_K = (\nu/\frac{3}{4}\nu_0)^{\frac{1}{2}}$; $Q_L = (\nu/5/36\ \nu_0)^{\frac{1}{2}}$ where ν is the frequency of the α line and ν_0 the fundamental Rydberg frequency. The atomic number for the K series = $Q_K + 1$; for the L series = $Q_L + 7.4$ approximately. $\nu_0 = 3.29 \times 10^{15}$.

Element	α line $\lambda \times 10^8$ cm.	Q_K	Atomic number N	β line $\lambda \times 10^8$ cm.	Element	α line $\lambda \times 10^8$ cm.	Q_L	Atomic number N	β line $\lambda \times 10^8$ cm.
Al	8.364	12.0	13	7.912	Zr	6.091	32.8	40	
Si	7.142	13.0	14	6.729	Cb	5.749	33.8	41	5.507
Cl	4.750	16.0	17		Mo	5.423	34.8	42	5.187
K	3.759	18.0	19	3.463	Ru	4.861	36.7	44	4.660
Ca	3.368	19.0	20	3.094	Rh	4.622	37.7	45	
Ti	2.758	21.0	22	2.524	Pd	4.385	38.7	46	4.168
V	2.519	22.0	23	2.297	Ag	4.170	39.6	47	
Cr	2.301	23.0	24	2.093	Sn	3.619	42.6	50	
Mn	2.111	24.0	25	1.818	Sb	3.458	43.6	51	3.245
Fe	1.946	25.0	26	1.765	La	2.676	49.5	57	2.471
Co	1.798	26.0	27	1.629	Ce	2.567	50.6	58	2.360
Ni	1.662	27.0	28	1.506	Pr	(2.471)	51.5	59	2.265
Cu	1.549	28.0	29	1.402	Md	2.382	52.5	60	2.175
Zn	1.445	29.0	30	1.306	Sa	2.208	54.5	62	2.008
Yt	0.838	38.1	39		Eu	2.130	55.5	63	1.925

X-RAY SPECTRA AND ATOMIC NUMBERS

(From Smithsonian Physical Tables)

Element	α line $\lambda \times 10^8$ cm.	Q_K	Atomic number N	β line $\lambda \times 10^8$ cm.	Element	α line $\lambda \times 10^8$ cm.	Q_L	Atomic number N	β line $\lambda \times 10^8$ cm.
Zr	0.794	39.1	40		Gd	2.057	56.5	64	1.853
Cb	0.750	40.2	41		Ho	1.914	58.6	66	1.711
Mo	0.721	41.2	42		Er	1.790	60.6	68	1.591
Ru	0.638	43.6	44		Ta	1.525	65.6	73	1.330
Pd	0.584	45.6	46		W	1.486	66.5	74	
Ag	0.560	46.6	47		Os	1.397	68.5	76	1.201
					Ir	1.354	69.6	77	1.155
					Pt	1.316	70.6	78	1.121
					Au	1.287	71.4	79	1.092

Moseley's summary condensed is as follows: Every element from Al to Au is characterized by an integer N which determines its X-ray spectrum; N is identified with the number of positive units of electricity in its atomic nucleus. The order of these atomic numbers (N) is that of the atomic weights except where the latter disagrees with the order of the chemical properties. Known elements correspond with all the numbers between 13 and 79 except 3. There are here 3 possible elements still undiscovered. The frequency of any line in the X-ray spectrum is approximately proportional to $A(N-b)^2$, where A and b are constants. All X-ray spectra of each series are similar in structure differing only in wave lengths.

RADIOACTIVITY

RADIOACTIVE SUBSTANCES

A list of the fully recognized radioactive substances and transformation products. In each series, each product is obtained from the substance preceding. The table gives also (1) the rays emitted, (2) the transformation period, that is, the time taken for half the active product to undergo change and (3) the radioactive constant, λ, the proportion of active matter which undergoes change each second.

Substance	Properties, etc.	Atomic wt.	Rays	Transformation period Γ	Transformation constant λ
Uranium I	Soluble in excess $(NH_4)_2CO_3$. One gram emits 2.37×10^4 α particles per second	238.5	α	5×10^9 yrs.	1.4×10^{-10} yrs.
Uranium 2	Inseparable from Ur 1	234.5	α	2×10^6 yrs.?	7×10^{-7} yrs.
Uranium X	Less volatile than Ur 1. Insoluble in excess of $(NH_4)_2CO_3$. Soluble in water and ether. Chemically allied to Th	230.5	β, γ	24.6 days (21.5)	0.0282 days
Uranium Y	Probably branch product exists in small quantity	230.5?	β	1.5 days	0.46 days
Ionium	Nonseparable from Th. Soluble in excess of ammon. oxalate. Carried down by H_2O_2 in presence of U salts	230.5	α	2×10^5 yrs. (3×10^4)	3.5×10^{-6} yrs.
Radium	Chemical properties of Ba. Characteristic spect. Spontaneously luminous. RBr_2 and RCl_2 less soluble than $BaBr_2$ and $BaCl_2$. One gr. in equilibrium emits 13.6×10^{10} α particles per sec.	226.4	α, β	2000 yrs. (1750)	3.5×10^{-6} yrs.
Radium emanation (Niton)	Inert gas, density 111 H. Boiling point $-65°$ C., density of solid 5–6	222	α	3.85 days	0.180 days
Radium A	Acts as solid. Has + charge, deposits on cathode in electric field. Volatile at 800–900° C. Soluble in strong acids	218	α	3 min.	0.231 min.

Substance	Properties, etc.	Atomic wt.	Rays	Transformation period Γ	Transformation constant λ
Radium B	Like Ra A. Volatile 600–700° C. Precipitated by $BaSO_4$. Separated pure by recoil from Ra A.	214	β, γ	26.8 min.	0.0258 min.
Radium C	Physically like Ra A, chemically like Ra B. Volatile 800–1300° C. Deposited on Cu and Ni. Perhaps a mixture	214	α, β, γ	19.5 min.	0.0355 min.
Radium C_2	Probably branch product. Separated by recoil from Ra C	210?	β	1.4 min.	0.495 min.
Radium D	Radio lead. Separated with Pb. Not separable. Volatile below 1000° C. Soluble in strong acids.	210	Slow β	16.5 yrs.	0.042 yrs.
Radium E	Reactions analogous to Pb. Volatile at red heat. Soluble in cold acetic acid	210	β	6.2 days (5 days)	1.3×10^{-6} sec. (.139 day)
Radium E_1	Not volatile at red heat. Reactions analogous to Bi	.....	β	4.8 days	1.7×10^{-6}sec.
Radium F (Polonium)	Separated with Bi. Probably changes to Pb. Volatile about 1000° C.	210	α	136 days (140)	0.00510 day
Actinium	Probably branch product Ur series. Chemically allied to lanthanum. Precipitated by oxalic acid in acid solutions. With thorium and rare earths.	.....	None	.....	.....
Radio-actinium	Slightly volatile at high temperature. Insoluble in NH_4OH	.....	α, β	19.5 days	0.0355 day
Actinium X	Not precipitated by NH_4OH. Chemical properties analogous to Ra	.....	α	10.2 days	0.068 day
Actinium emanation	Inert gas, condenses −120 to −150	.....	α	3.9 sec.	0.178 sec.
Actinium A	Analogous to Ra A. Volatile above 400° C. Soluble in NH_4OH and strong acids	.....	α	0.002 sec.	350 sec.
Actinium B	Analogous to Ra B. Volatile below 700° C. Soluble in NH_4OH and strong acids	.....	Slow β	36 min.	0.0193 min.
Actinium C	Analogous to Ra C	.....	α	2.1 min.	0.33 min.
Actinium D	Analogous to Ra D	.....	$\beta+\gamma$	4.7 min.	0.147 min.

RADIOACTIVE SUBSTANCES

A list of the fully recognized radioactive substances and transformation products. In each series, each product is obtained from the substance preceding. The table gives also (1) the rays emitted, (2) the transformation period, that is, the time taken for half the active product to undergo change and (3) the radioactive constant, λ, the proportion of active matter which undergoes change each second.

Substance	Properties, etc.	Atomic wt.	Rays	Transformation period Γ	Transformation constant λ
Thorium	Volatile in arc. Colorless salts not spontaneous by phosphorescent salts precipitated by NH_4OH and oxalic acid	232	α	1.3×10^{10} yrs. (3×10^{10})	5.3×10^{-11} yr.
Mesothorium 1	Chemical properties analogous to Ra, from which it is inseparable	228	None	5.5 yrs.	0.126 yr.
Mesothorium 2		228	β, γ	6.2 yrs.	0.112 yr.
Radiothorium	Chemically allied to thorium, from which it is non-separable	228	α	2 yrs.	0.347 yr.
Thorium X	Chemically analogous to Ra. Soluble in NH_4OH.	224	α, β	3.65 days	0.190 day
Thorium emanation	Inert gas. Condenses just above $-120°$ C	220	α	54 sec.	0.0128 sec.
Thorium A	Volatile under 630° C. Positively charged. Soluble in strong acids	216	α	0.14 sec.	4.95 sec.
Thorium B	Chemically analogous to Ra B. Volatile above 630° C. and below 730° C.	212	β, γ	10.6 hours	0.0654 hour
Thorium C	Chemically analogous to Ra C. Volatile above 730.	212	α, β	60 min.	0.0118 min.
Thorium C_2	Th C_2 and Th D are probably β and λ ray products respectively from Th C	212	α	Short	.....
Thorium D	By recoil from Th C. Probably transforms to Bi	208	$\beta+\gamma$	3.1 min.	0.224 min.
Potassium	Activity 1/1000 that of U	39.1	β	.....	.....
Rubidium	Activity 1/500 that of U	85.5	β	.....	.....

RADIOACTIVITY, PROPERTIES OF RAYS

Range of the α particle at 76.0 cm. and 15° C. Initial velocity is deduced from formula $V^3 = aR$, where R is range. **Velocity for *RaC* of range 7.06 at 20° is assumed 2.06×10^9 cm. per sec. or $v = 1.077r^{1/3}$.**

If μ is the coefficient of absorption, d the thickness of absorbing medium, I_0 the intensity before passage, — the intensity after passage $I = I_0 e^{-d\mu}$. μ for β rays is in terms of cms. of Al; for γ rays, cms. of lead.

Substance	α Rays				β Rays		γ Rays
	Range cm.	Initial velocity cm. per sec.	Kinetic energy ergs,	Total number of ions produced by α part.	Absorption coefficient (Al)	Velocity, vel. of light taken as 1	Absorption coefficient (Pb)
Uranium 1	2.50	1.45×10^9	0.65×10^{-5}	1.26×10^5	.....	.....	.....
Uranium 2	2.90	1.53	0.72	137	.....	.....	.....
Uranium X	.....	.....	.....	.....	15510	Wide range	0.72
Uranium Y	.....	.....	.....	.....	.....	.....	.....
Ionium	3.00	1.56×10^9	0.75×10^{-5}	1.40×10^5	.....	.....	.....
Radium	3.30	1.61	0.79	1.50	312	0.52–0.65	.....
Radium emanation	4.16	1.73	0.92	1.74	.....	.....	.....
Radium A	4.75	1.82	1.01	1.88	.....	.....	.....
Radium B	.....	.....	.....	.....	13, 80, 890	0.36–0.74	4 to 6
Radium C1	6.94	2.06	1.31	2.37	13, 53	0.80–0.98	0.50
Radium C2	.....	.....	.....	.....	13	.....	.....
Radium D	.....	.....	.....	.....	0.33, 0.39	.....	.....
Radium E	.....	.....	.....	.....	43	Wide range	.....
Radium F (Polonium)	3.77	1.68	0.87	1.63	.....	.....	.....

Substance	α Rays				β Rays		γ Rays
	Range cm.	Initial velocity cm. per sec.	Kinetic energy ergs.	Total number of ions produced by α part.	Absorption coefficient (Al)	Velocity, vel. of light taken as 1	Absorption coefficient (Pb)
Actinium	.....	.....	.....	.....	.....	.....	.....
Radio-actinium	4.80	1.83×10^{9}	1.02×10^{-6}	1.89×10^{5}	140	.....	.....
Actinium X	4.40	1.76	0.94	1.79	.....	.....	.....
Actinium emanation	5.70	1.94×10^{9}	1.15×10^{-6}	2.10×10^{5}	.....	.....	.....
Actinium A	5.50	2.02	1.25	2.27	.....	.....	.....
Actinium B	.....	.....	.....	.....	Very soft	.....	.....
Actinium C	5.40	1.89	1.10	2.02	.....	.....	.....
Actinium D	.....	.....	.....	.....	28.5	.....	0.217 (Al)
Thorium	2.72	1.50×10^{9}	0.69×10^{-6}	1.32×10^{5}	.....	.....	.....
Mesothorium 1	.....	.....	.....	.....	.....	0.37–0.66	.....
Mesothorium 2	.....	.....	.....	.....	20–385	.....	0.53
Radiothorium	3.87	1.70	0.89	1.66	.....	.....	.....
Thorium X	5.7	1.94	1.15	2.1	330.	.47–.51	.....
Thorium emanation	5.5	1.90	1.10	2.0	.....	.....	.....
Thorium A	5.9	1.97	1.19	2.2	.....	.....	.....
Thorium B	.....	.....	.....	.....	110.	0.63–0.72	.....
Thorium C_1	5.0	1.85	1.05	1.9	15.6	.....	Weak
Thorium C_2	8.6	2.22	1.53	2.0	.....	.....	.....
Thorium D	.....	.....	.....	.....	24.8	.3, .4, .93–5	0.46
Potassium	.....	.....	.....	.....	38, 102	.....	.....
Rubidium	.....	.....	.....	.....	380, 1020	.....	.....

INTERNATIONAL TABLE OF THE RADIOACTIVE ELEMENTS AND THEIR CONSTANTS (1923)

T	Uranium and Radium Series		Atomic		Isotope	Radiation	α_o
	Name	Symbol	WT.	NO.			
4.67×10^9 years	Uranium I	UI	238	92	U	α	2.37
24.6 days	Uranium X_1	UX^2	234	90	Th	β	.....
1.15 minutes	Uranium X_2	UX^2	234	91	Pa	$\beta(\gamma)$	.....
2×10^6 years	Uranium II	UII	234	92	U	α	2.75
6.9×10^4 years	Ionium	Io	230	90	Th	α	2.85
1690 years	Radium	Ra	226	88	Ra	$\alpha(\beta + \gamma)$	3.13
3.85 days	Radon	Rn	222	86	Rn	α	3.94
3.0 minutes	Radium A	RaA	218	84	Po	α	4.50
26.8 minutes	Radium B	RaB	214	82	Pb	$\beta(\gamma)$	.....
19.5 minutes	Radium C	RaC	214	83	Bi	99.97% β & γ	.....
10^{-6} second	Radium C′	RaC′	214	84	Po	α	6.57
16.5 years	Radium D	RaD	210	82	Pb	(β and γ)	.....
5.0 days	Radium E	RaE	210	83	Bi	β	.....
136 days	Radium F (Polonium)	RaF (Po)	210	84	Po	$\alpha(\gamma)$	3.58
.....	Radium Ω′ (Lead)	RaΩ′ Pb^{206}	206	82	Pb	.....	.....
.....	Radium C	RaC	214	83	Bi	0.03% α	?
.....	Radium C″	RaC″	210	81	Tl	β	.....
1.4 minutes	Radium Ω″	RaΩ″	210	82	Pb	.....	.....
.....	(hypothetical)						

Actinium Series

.....	Uranium ?	.....	?	92	U	α	.....
1.04 days	Uranium Y	UY	?	90	Th	β	.....
1.2×10^4 years	Protoactinium	Pa	?	91	Pa	α	3.314
20 years	Actinium	Ac	?	89	Ac	$\overline{\quad}$	.....
19.5 days	Radioactinium	RdAc	?	90	Th	$\alpha(\beta)$	4.36
11.4 days	Actinium X	AcX	?	88	Ra	α	4.17
3.9 seconds	Actinon	An	?	86	Rn	α	5.40

Actinium Series (Continued)

T	Uranium and Radium Series		Atomic		Isotope	Radiation	α_1
	Name	Symbol	WT.	NO.			
2.0×10^{-3} second	Actinium A	AcA	?	84	Po	α	6.16
36.1 minutes	Actinium B	AcB	?	82	Pb	(β and γ)	....
2.15 minutes	Actinium C	AcC	?	83	Bi	α	5.12
4.71 minutes	Actinium C″	AcC″	?	81	Tl	β and γ	....
....	Actinium Ω″ (hypothetical)	AcΩ″	?	82	Pb	....	....

Thorium Series

1.31×10^{10} years	Thorium	Th	232	90	Th	α	2.58
6.7 years	Mesothorium 1	MsTh1	228	88	Ra	—	....
6.2 hours	Mesothorium 2	MsTh2	228	89	Ac	β and γ	....
2.02 years	Radiothorium	RdTh	228	90	Th	$\alpha(\beta)$	3.67
3.64 days	Thorium X	ThX	224	88	Ra	α	4.08
54 seconds	Thoron	Tn	220	86	Rn	α	4.74
0.14 second	Thorium A	ThA	216	84	Po	α	5.40
10.6 hours	Thorium B	ThB	212	82	Pb	β and γ	....
60 minutes	Thorium C	ThC	212	83	Bi	65% β	....
10^{-11} second	Thorium C′	ThC′	212	84	Po	α	8.16
....	Thorium Ω′ (Lead)	ThΩ′ Pb^{208}	208	82	Pb	....	....
....	Thorium C	ThC	212	83	Bi	35% α	?4.69
3.1 minutes	Thorium C″	ThC″	208	81	Tl	β and γ	....
....	Thorium Ω″ (Lead)	ThΩ″ Pb^{208}	208	82	Pb	....	....
....	Potassium	K	39.1	19	K	β	....
....	Rubidium	Rb	85.5	37	Rb	β	....

In the table above, T is the time in which the quantity of radio-element is diminished to one-half, α_1 is the range in cm. of the α-rays in the air at 0° C. and a pressure of 760 mm. of mercury and, under the heading "Radiation," the parentheses ( ) indicate that the radiation is relatively feeble.

INTERNATIONAL TABLE OF ISOTOPES (1923)

Jour. Soc. Chem. Ind., 42, 8 (1923)

Element	Atomic No.	Atomic Weight (1)	Masses of Isotopes (2)	Accuracy %
H	1	1.008	1.008	0.02
He	2	4.00	4	0.2
Li	3	6.94	7; 6	
Gl	4	9.1	9	
B	5	10.9	11; 10	0.1
C	6	12.005	12	
N	7	14.008	14	0.2
O	8	16.000	16	
F	9	19.0	19	0.1
Ne	10	20.2	20; 22	0.1
Na	11	23.00	23	
Mg	12	24.32	24; 25; 26	
Al	13	27.0	27	
Si	14	28.1	28; 29; (30)	0.1
P	15	31.04	31	0.2
S	16	32.06	32	0.2
Cl	17	35.46	35; 37	0.1
A	18	39.9	40; 36	0.1
K	19	39.10	39; 41	
Ca	20	40.07	40; (44)	
Fe	26	55.84	56; (54)?	
Ni	28	58.68	58; 60	0.1
Zn	30	65.37	64; 66; 68; 70	
As	33	74.96	75	0.1
Se	34	79.2	80; 78; 76; 82; 77; 74	0.1
Br	35	79.92	79; 81	0.1
Kr	36	82.92	84; 86; 82; 83; 80; 78	0.1
Rb	37	85.45	85; 87	
Sn	50	118.7	120; 118; 116; 124; 119; 117; 122; (121)	
I	53	126.92	127	0.2
Xe	54	130.2	129; 132; 131; 134; 136; 128; 130; (126); (124)	0.1
Cs	55	132.81	133	
Hg	80	200.6	(197–200); 202; 204	0.1

(1) International values for 1922. (2) In order of intensi
of spectral bands. (3) Of the observations Aston is responsib
for all save those of glucinium, magnesium, calcium and zin
Dempster for those of lithium, magnesium, calcium, and zin
and Thomson for those of lithium and glucinium.

DECLINATION OF THE SUN AND EQUATION OF TIME

Date.		Declination.	Diff. 1 day.	Equation of time.		Date.		Declination.	Diff. 1 day.	Equation of time.	
		°	°	m	s			°	°	m	s
Jan.	0	−23.1	0.11	+ 3	15	July	9	+22.4	0.15	+ 4	49
	10	−22.0	0.18	+ 7	42		19	+20.9	0.21	+ 5	58
	20	−20.2	0.25	+11	13		29	+18.8	0.26	+ 6	13
	30	−17.7	0.30	+13	32	Aug.	8	+16.2	0.30	+ 5	27
Feb.	9	−14.7	0.34	+14	27		18	+13.2	0.34	+ 3	44
	19	−11.3	0.37	+14	5		28	+ 9.8	0.36	+ 1	11
Mar.	1	− 7.6	0.38	+12	36	Sept.	7	+ 6.2	0.39	− 1	59
	11	− 3.8	0.40	+10	15		17	+ 2.3	0.39	− 5	26
	21	+ 0.2	0.39	+ 7	23		27	− 1.5	0.38	− 8	55
	31	+ 4.1	0.38	+ 4	19	Oct.	7	− 5.4	0.38	−12	4
Apr.	10	+ 7.9	0.35	+ 1	23		17	− 9.2	0.35	−14	31
	20	+11.4	0.33	− 1	5		27	−12.7	0.32	−16	0
	30	+14.7	0.29	− 2	52	Nov.	6	−15.9	0.26	−16	16
May	10	+17.6	0.23	− 3	48		16	−18.7	0.22	−15	7
	20	+19.9	0.18	− 3	45		26	−20.9	0.16	−12	36
	30	+21.7	0.12	− 2	49	Dec.	6	−22.5	0.08	− 8	54
June	9	+22.9	0.05	− 1	11		16	−23.3	0.01	− 4	17
	19	+23.4	0.01	+ 0	55		26	−23.4	0.08	+ 0	41
	29	+23.3	0.09	+ 3	2	Jan.	5	−22.6	....	+ 5	34

MEAN PLACES OF STARS

Jan. 0, 1925

Name of star	Right ascen.			Annual var.	Declination			Annual var.
	h.	m.	s.	s.	°	′	″	″
α Andromedæ (Alpheratz)	0	4	30.34	+ 3.10	+28	40	35.13	+19.88
α Ursæ Minoris (Polaris)	1	34	14.51	+31.14	+88	54	10.94	+18.37
α Arietis	2	2	56.40	+ 3.38	+23	6	30.80	+17.09
α Persei	3	18	57.46	+ 4.27	+49	35	44.29	+12.93
α Tauri (Aldebaran)	4	31	36.84	+ 3.44	+16	21	35.31	+ 7.36
β Orionis (Rigel)	5	10	55.92	+ 2.88	− 8	17	13.65	+ 4.26
α Aurigæ (Capella)	5	11	8.70	+ 4.43	+45	55	24.70	+ 3.82
ε Orionis	5	32	24.37	+ 3.04	− 1	14	54.86	+ 2.41
β Aurigæ	5	54	1.55	+ 4.40	+44	56	29.65	+ 0.52
β Canis Majoris	6	19	23.74	+ 2.64	−17	55	3.46	− 1.69
α Canis Majoris (Sirius)	6	41	50.66	+ 2.64	−16	36	43.81	− 4.85
ε Canis Majoris	6	55	40.62	+ 2.36	−28	52	8.60	− 4.82
α Canis Minoris (Procyon)	7	35	22.57	+ 3.14	+ 5	25	5.98	− 9.14
α Hydræ	9	23	54.09	+ 2.95	− 8	19	57.91	−15.54
α Leonis (Regulus)	10	4	22.75	+ 3.20	+12	20	3.97	−17.54
α Ursæ Majoris	10	59	6.80	+ 3.72	+62	9	22.60	−19.41
β Leonis (Denebola)	11	45	14.09	+ 3.06	+14	59	28.86	−20.12
ε Ursæ Majoris (Alioth)	12	50	44.06	+ 2.64	+56	22	0.43	−19.56
α Virginis (Spica)	13	21	14.32	+ 3.16	−10	46	13.05	−18.83
α Boötis (Arcturus)	14	12	14.35	+ 2.73	+19	34	20.21	−18.79
β Ursæ Minoris	14	50	54.30	− 0.20	+74	27	43.34	−14.72
α Scorpii (Antares)	16	24	48.29	+ 3.67	−26	16	0.53	− 8.11
λ Scorpii	17	28	30.79	+ 4.07	−37	3	1.91	− 2.77
α Ophiuchi	17	31	27.08	+ 2.78	+12	36	48.64	− 2.71
δ Ursæ Minoris	17	56	25.17	−19.50	+86	36	50.00	− 0.26
α Lyræ (Vega)	18	34	23.88	+ 2.03	+38	42	46.73	+ 3.28
α Aquilæ (Altair)	19	47	7.42	+ 2.93	+ 8	40	9.31	+ 9.42
α Cygni (Deneb)	20	38	52.41	+ 2.04	+45	0	41.97	+12.81
α Piscis Austr. (Formalhaut)	22	53	30.60	+ 3.32	−30	1	12.16	+19.05
α Pegasi (Markab)	23	1	1.36	+ 2.99	+14	48	5.21	+19.35

APPROXIMATE CORRECTION FOR REFRACTION

FOR ASTRONOMICAL OBSERVATIONS

Corresponding to temperature of 50° F., and to a barometric pressure of 29.6 inches.

(From Young's General Astronomy, by permission.)

Altitude.	Refraction.	Altitude.	Refraction.	Altitude.	Refraction.
°	′ ″	°	′ ″	°	′ ″
0	34 50	11	4 47.7	30	1 39.5
1	24 22	12	4 24.5	35	1 22.1
2	18 06	13	4 04.4	40	1 08.6
3	14 13	14	3 47.0	45	57.6
4	11 37	16	3 18.2	50	48.3
5	9 45	18	2 55.5	55	40.3
6	8 23	20	2 37.0	60	33.2
7	7 19	22	2 21.6	65	26.8
8	6 29	24	2 08.6	70	20.9
9	5 49	26	1 57.6	80	10.2
10	5 16	28	1 48.0	90	0.0

For every 5° F. by which the temperature is less than 50° F., add one per cent to the tabular refraction, and decrease it in the same ratio for temperatures above 50° F.

Increase the tabular refraction by three and a half per cent for every inch of barometric pressure above 29.6 inches, and decrease it in the same ratio below that point. These corrections for temperature and pressure, though only approximate, will give a result correct within 2″ except in extreme cases.

DATA IN REGARD TO THE EARTH

(Radius, U. S. C. & G. Survey.)

Equatorial radius, 6,378,388 meters, 3,963.399 miles.
Polar radius, 6,365,909 meters, 3,949.992 miles.
1° latitude at the equator = 68.70 miles.
1° latitude at the pole = 69.41 miles.
Mean density of the earth, 5.52 g. per cu.cm.
Mean distance from the earth to the sun
149,500,000 kilometers,
92,900,000 miles.
Mean distance from the earth to the moon
384,393 kilometers,
238,854 miles.

DATA CONCERNING THE SOLAR SYSTEM

(Values from Young's General Astronomy, by permission.)

Name.	Mean dis. from sun, millions of miles.	Period in years.	Mean dia. in miles.	Mass, the earth =1.	Mean density, water =
Mercury.....	36.0	0.24	3030	0.047	4.70
Venus.....	67.2	0.62	7700	0.82	4.94
The earth....	92.9	1.00	7917.6	1.000	5.55
Mars.....	141.5	1.88	4230	0.107	3.92
Jupiter.....	483.3	11.86	86500	317.7	1.32
Saturn.....	886.0	29.46	73000	94.8	0.72
Uranus.....	1781.9	84.02	31900	14.6	1.22
Neptune....	2791.6	164.78	34800	17.0	1.11
Sun.....	.....	.....	866400	332000.	1.39
Moon.....	.....	.....	2163	0.0123	3.39

METEOROLOGICAL DATA

The Atmosphere

Total mass, estimated by Elkholm:
5.2×10^{21} grams.
11.4×10^{18} pounds.
Composition:
The total volume =1.

Substance.	Elevation.		
	Sea level.	10000 meters.	50000 meters.
Argon	0.009	0.006	0.0003
Carbon dioxide	0.0003	0.00015	0.0000
Helium	0.0000015	0.0000	0.00126
Hydrogen	0.0001	0.00035	0.136
Neon	0.000015	0.00002	0.0000
Nitrogen	0.780	0.812	0.792
Oxygen	0.210	0.182	0.070

Atmospheric Potential

The potential of the atmosphere increases with the elevation 130 to 200 volts per meter.

Velocity of Seismic Waves in the Earth's Crust

Longitudinal	4 to 14 kilometers per sec.
Transverse	3 to 10 kilometers per sec.

Angular Radius of Halos and Rainbows

Coronæ due to small water drops	1° to 10°
Small halo, due to 60° angles of ice crystals	22°
Large halo, due to 90° angles of ice crystals	46°
Rainbow, primary	41° 20′
Rainbow, secondary	52° 15′

Solar Constant

The energy falling on one sq.cm. area at normal incidence equals 1.92 small calories per minute.

ACCELERATION DUE TO GRAVITY, LATITUDE, LONGITUDE AND ELEVATION

UNITED STATES

Station.	Latitude.			Longitude (Greenwich).			Elevation, meters.	g cm/sec.^{2}
	°	′	″	°	′	″		
Atlanta, Ga.	33	44	58	84	23	18	324	979.523
Austin, Tex. (University)	30	17	11	97	44	14	189	979.282
Austin, Tex. (Capitol)	30	16	30	97	44	16	170	979.287
Baltimore, Md.	39	17	50	76	37	30	30	980.096
Boston, Mass.	42	21	33	71	03	50	22	980.395
Calius, Me.	45	11	11	67	16	54	38	980.630
Cambridge, Mass.	42	22	48	71	07	45	14	980.397
Charleston, S. C.	32	47	14	79	56	03	6	979.545
Charlottesville, Va.	38	02	01	78	30	16	166	979.937
Chicago, Ill.	41	47	25	87	36	03	182	980.277
Cincinnati, Ohio	39	08	20	84	25	20	245	980.003
Cleveland, Ohio	41	30	22	81	36	38	210	980.240
Colorado Springs, Colo.	38	50	44	104	49	02	1841	979.489
Deer Park, Md.	39	25	02	79	19	50	770	979.934
Denver, Colo.	39	40	36	104	56	55	1638	979.608
Ellsworth, Kansas	38	43	43	98	13	32	469	979.925
Ft. Egbert, Eagle, Alaska	64	47	22	141	12	24	174	982.182
Galveston, Texas	29	18	12	94	47	29	3	979.271
Grand Canyon, Wyo.	44	43	16	110	29	44	2386	979.898
Grand Junction, Colo.	39	04	09	108	33	56	1398	979.632
Green River, Utah	38	59	23	110	09	56	1243	979.635
Gunnison, Colo.	38	32	33	106	56	02	2340	979.341
Ithaca, N. Y.	42	27	04	76	29	00	247	980.299
Kansas City, Mo.	39	05	50	94	35	21	278	979.989
Key West, Fla.	24	33	33	81	48	25	1	978.969
Laredo, Texas	27	30	29	99	31	12	129	979.081
Little Rock, Ark.	34	44	37	92	16	24	89	979.720
Lower Geyser Basin, Wyo.	44	33	21	110	48	08	2200	979.931
Madison, Wis. (Univ. of Wis.)	43	04	35	89	24	00	270	980.364
New Orleans, La.	29	56	58	90	04	14	2	979.323
New York, N. Y.	40	48	27	73	57	43	38	980.266
Norris Geyser Basin, Wyo.	44	44	09	110	42	02	2276	979.949

ACCELERATION DUE TO GRAVITY, LATITUDE, LONGITUDE AND ELEVATION (Continued)

UNITED STATES (Continued)

Station.	Latitude.			Longitude (Greenwich).			Elevation, meters.	g cm/sec².
	°	′	″	°	′	″		
Philadelphia, Pa.	39	57	06	75	11	40	16	980.195
Pike's Peak, Colo.	38	50	20	105	02	02	4293	978.953
Pleasant Valley Junction, Utah	39	50	47	111	00	46	2191	979.511
Princeton, N. J.	40	20	57	74	39	28	64	980.177
Salt Lake City, Utah	40	46	04	111	53	46	1322	979.802
San Francisco, Cal.	37	47	00	124	46	00	114	979.965
St. Louis, Mo.	38	38	03	90	12	13	154	980.000
Terre Haute, Ind.	39	28	42	87	23	49	151	980.071
Wallace, Kans.	38	54	44	101	35	26	1005	979.754
Washington, C. & G. S.	38	53	13	77	00	32	14	980.111
Washington, Smithsonian	38	53	20	77	01	32	10	980.113
Worcester, Mass.	42	16	29	71	48	28	170	980.323

FOREIGN CITIES

Station.	Latitude.		Longitute (Paris).		Elevation, meters.	g cm/sec².
	°	′	°	′		
Berlin	+52	30	+ 11	4	38	981.287
Calcutta, India	+22	33	+ 86	1	6	978.822
Cape of Good Hope, Africa	−33	56	+ 16	9	11	979.659
Honolulu, Hawaii	+21	18	−160	12	3	978.966
London (Greenwich)	+51	17	− 2	12	48	981.188
Madrid	+40	24	− 6	1	656	979.981
Melbourne, Australia	−37	50	+142	38	27	979.985
Paris	+48	50	0	0	60	980.943
Rio de Janeiro, Brazil	−22	54	− 45	30	45	978.801
Rome	+41	54	+ 10	9	59	980.350
St. Petersburg	+59	56	+ 27	59	2	981.938
Shanghai, China	+31	12	+119	6	8	979.443
Stockholm	+59	21	+ 15	43	45	981.843
Tokio, Japan	+35	43	+137	26	18	979.801
Valparaiso, Chili	−33	2	− 73	58	0	979.630

MOMENT OF INERTIA FOR VARIOUS BODIES

The mass of the body is indicated by m.

Body.	Axis.	Moment of inertia.
Uniform thin rod	Normal to the length, at one end	$m\frac{l^2}{3}$
Uniform thin rod	Normal to the length, at the center	$m\frac{l^2}{12}$
Thin rectangular sheet, sides a and b	Through the center parallel to b	$m\frac{a^2}{12}$
Thin rectangular sheet, sides a and b	Through the center perpendicular to the sheet	$m\frac{a^2+b^2}{12}$
Thin circular sheet of radius r	Normal to the plate through the center	$m\frac{r^2}{2}$
Thin circular sheet of radius r	Along any diameter	$m\frac{r^2}{4}$
Thin circular ring. Plane figure formed by two concentric circles of radius r_1 and r_2	Through center normal to plane of ring	$m\frac{r_1^2+r_2^2}{2}$
Thin circular ring. Plane figure formed by two concentric circles of radius, r_1 and r_2	Any diameter	$m\frac{r_1^2+r_2^2}{4}$
Rectangular parallelopiped, edges a, b, and c	Through center perpendicular to face ab, (parallel to edge c)	$m\frac{a^2+b^2}{12}$
Sphere, radius r	Any diameter	$m\frac{2}{5}r^2$
Spherical shell, external radius, r_1 internal, radius r_2	Any diameter	$m\frac{2}{5}\frac{(r_1^5-r_2^5)}{(r_1^3-r_2^3)}$

MOMENT OF INERTIA FOR VARIOUS BODIES (Continued)

The mass of the body is indicated by m.

Body.	Axis.	Moment of inertia.
Spherical shell, very thin, mean radius, r	Any diameter	$m\frac{2r^2}{3}$
Right circular cylinder of radius r, length l	The longitudinal axis of the solid	$m\frac{r^2}{2}$
Right circular cylinder of radius r, length l	Through center perpendicular to the axis of the figure, (transverse diameter)	$m\left(\frac{r^2}{4}+\frac{l^2}{12}\right)$
Hollow circular cylinder, length l, external radius r_1 internal radius r_2	The longitudinal axis of the figure	$m\frac{(r_1^2+r_2^2)}{2}$
Thin cylindrical shell, length l, mean radius, r	The longitudinal axis of the figure	mr^2
Hollow circular cylinder, length l, external radius r, internal radius r_2	Transverse diameter	$m\left[\frac{r_1^2+r_2^2}{4}+\frac{l^2}{12}\right]$
Hollow circular cylinder, length l, very thin, mean radius r	Transverse diameter	$m\left(\frac{r^2}{2}+\frac{l^2}{12}\right)$
Elliptic cylinder, length l, transverse semiaxes a and b	Longitudinal ax.	$m\left(\frac{a^2+b^2}{4}\right)$
Right cone, altitude h, radius of base r	Axis of the figure	$m\frac{3}{10}r^2$
Spheroid of revolution, equatorial radius r	Polar axis	$m\frac{2r^2}{5}$
Ellipsoid, axes $2a$, $2b$, $2c$	Axis $2a$	$m\frac{(b^2+c^2)}{5}$

ACCELERATION DUE TO GRAVITY AND LENGTH OF THE SECONDS PENDULUM

FOR SEA LEVEL AT DIFFERENT LATITUDES

Latitude.	g cm./sec.²	g ft./sec.²	Length in cm.	Length in ins.
0°	977.989	32.0862	99.0910	39.0121
5	8.029	.0875	.0950	.0137
10	.147	.0916	.1079	.0184
15	.339	.0977	.1265	.0261
20	.600	.1062	.1529	.0365
25	978.922	32.1168	99.1855	39.0493
30	9.295	.1290	.2234	.0642
31	.374	.1316		
32	.456	.1343		
33	.538	.1370		
34	979.622	32.1398		
35	.707	.1425	.2651	.0806
36	.793	.1454		
37	.880	.1490		
38	.963	.1511		
39	980.057	32.1540		
40	.147	.1570	.3096	.0982
41	.237	.1607		
42	.327	.1630		
43	.418	.1659		
44	980.509	32.1688		
45	.600	.1719	.3555	.1163
46	.691	.1748		
47	.782	.1778		
48	.873	.1808		
49	980.963	32.1838		
50	1.053	.1867	99.4014	39.1344
51	.143	.1896		
52	.231	.1924		
53	.318	.1954		
54	981.407	32.1983		
55	.493	.2011	.4459	.1520
56	.578	.2039		
57	.662	.2067		
58	.744	.2094		
59	981.825	32.2121		
60	.905	.2147	.4876	.1683
65	2.278	.2276	.5255	.1832
70	.600	.2375	.5581	.1960
75	.861	.2460	99.5845	39.2065
80	983.053	32.2523	.6040	.2147
85	.171	.2562	.6160	.2188
90	.210	.2575	.6200	.2204

ATOMIC AND MOLECULAR CONSTANTS

(From Smithsonian Physical Tables)

Elementary electrical charge, charge on electron, $\frac{1}{2}$ charge on α particle,
$e = 4.774 \times 10^{-10}$ e.s.u.
$= 1.591 \times 10^{-20}$ e.m.u.
$= 1.591 \times 10^{-19}$ coulombs

Mass of an electron, m = about 9.01×10^{-28} grams

Ratio e/m, small velocities, $e/m = 1.766 \times 10^{7}$ e.m.u.gm^{-1}

Radius of an electron, l = about 2×10^{-13} cm.

Number of molecules per gram molecule, $N = 6.06 \times 10^{23}$ gr^{-1}

Number of gas molecules per cc., 760^{mm}, 0° C., $n = 2.70 \times 10^{19}$

Kinetic energy of a molecule at 0 °C., $E_0 = 5.62 \times 10^{-14}$ ergs

Constant of molecular energy, E_0/T, $\epsilon = 2.06 \times 10^{-16}$ ergs/degrees

Constant of entropy equation (Boltzmann), $= R/N = p_0V_0/TN = (2/3)\,\epsilon$, $k = 1.37 \times 10^{-16}$ " "

Elementary "Wirkungsquantum," $h = 6.547 \times 10^{-27}$ erg. sec.

Mass of hydrogen atom, $= 1.662 \times 10^{-24}$ gram

Radius of an atom, = about 10^{-8} cm.

Rydberg's fundamental frequency $V_0 = 3.28880 \times 10^{15}$

Rydberg's constant $= \frac{V_0}{C}$ $= 109675.$

Mol (e) of gas, 76^{cm} pressure, 0° C., $= 22.4$ liters

$PV_m = RT$, V_m = vol. of molec. wt. in grams,

when P in grams per cm^2, V_m in cm^3, $R = 84.780$ gram. cm.

when P in atmospheres, V_m in liter, $R = 0.08204$ l. atm.

when P in dynes, V_m in cm^3, $R = 8.31 \times 10^7$ ergs

	H_2	He	N_2	O_2	Xe	CO_2	H_2O
Sq. rt. of mean sq. molec. veloc., cm./sec. at 0°C. $\times 10^{-4}$	18.4	13.1	4.93	4.61	2.28	3.92	7.08
Mean free path cm. $\times 10^6$	18.	28.	9.4	9.9	5.6	6.4	7.2
Molecular diameter cm. $\times 10^8$	2.2	2.2	3.3	3.3	3.4	4.2	3.8

MISCELLANEOUS CONSTANTS

Mean radius of the earth, 6.371×10^8 cm. = 6371 kilometers.
1 degree of latitude at 40° = 69 miles.
1 knot or nautical mile = 1′ of arc on the earth's surface at the equator.
Mean density of the earth, 5.52 grams per cu.cm.
Constant of gravitation, $K = 6.667 \times 10^{-8}$ = the attraction in dynes between two gram masses one centimeter apart.
Acceleration due to gravity at sea level, lat. 45° = 980.60 cm. per sec. per sec. = 32.172 feet per sec. per sec.
Length of seconds pendulum at sea level, lat. 45° = 99.356 cm. = 39.116 in.

Density of mercury at 0° C. = 13.5955 g. per c.c.
Density of water, maximum at 3.98° C. = 0.999973 g. per c.c.
Density of dry air at 0° C. and 760 mm. = .001293 g. per c.c.

Velocity of sound in dry air at 0° C., 33,136 cm. per sec. = 1089 feet per sec.
Velocity of light in a vacuum = 2.9989×10^{10} cm. per sec. = 984×10^6 feet per sec.

Heat equivalent of fusion of water 79.24 cal. per gram.
Heat equivalent of vaporization of water, 535.9 cal. per gram.
Coefficient of expansion of gases, .003665.
Specific heat of air, at constant pressure, 0.238.

Electrochemical equivalent of silver, 0.001118 g. per sec. per ampere.
Mean wave length of sodium light, .00005893 cm. or 5893. ångström units.
Absolute wave length of red cadmium line in air, 760 mm. pressure, 15° C., ångström units: 6438.4722 (Michelson); 6438.4696 (Fabry and Perot).

GREEK ALPHABET

Greek letter	Greek name	English equivalent	Greek letter	Greek name	English equivalent
A α	Alpha	a	N ν	Nu	n
B β	Beta	b	Ξ ξ	Xi	x
Γ γ	Gamma	g	O o	Omicron	ŏ
Δ δ	Delta	d	Π π	Pi	p
E ϵ	Epsilon	ĕ	P ρ	Rho	r
Z ζ	Zeta	z	Σ σ	Sigma	s
H η	Eta	ē	T τ	Tau	t
Θ θ	Theta	th	Y υ	Upsilon	u
I ι	Iota	i	Φ ϕ	Phi	ph
K κ	Kappa	k	X χ	Chi	ch
Λ λ	Lambda	l	Ψ ψ	Psi	ps
M μ	Mu	m	Ω ω	Omega	ō

DEFINITIONS AND FORMULÆ

FUNDAMENTAL CHEMICAL LAWS

Scientific laws are statements of facts which have been established by direct experiment.

Boyle's Law for Gases. — At a constant temperature the volume of a given quantity of any gas varies inversely as the pressure to which the gas is subjected. This idea is expressed in the following formulæ:

PV = a constant, or $P = 1/V$, or $V = 1/P$, or $PV = P_1V_1$

The Law of Combining Weights. — If the weights of elements which combine with each other be called their "combining weights," then elements always combine either in the ratio of their combining weights or of simple multiples of these weights.

Law of Definite Proportions. — In every sample of each compound substance the proportions by weight of the constituent elements are always the same.

Dalton's Law of Partial Pressures. — The pressure exerted by a mixture of gases is equal to the sum of the separate pressures which each gas would exert if it alone occupied the whole volume. This fact is expressed in the following formula:

$$P\,V = V(p_1 + p_2 + p_3, \text{ etc.})$$

Faraday's Law. — The amounts of decomposition effected by the passage of equal quantities of electricity through them are, for the same electrolyte, equal, and for different electrolytes are proportional to the combining weights of the elements or radicles which are deposited.

Gay-Lussac's Law for Gases (or Charles' Law). — At a constant pressure, the volume of a given quantity of any gas increases about 1/273 of its volume at 0° C. for each rise of 1° C. and at constant volume the pressure of a given quantity of any gas increases about 1/273 of the pressure at 0° C. for each rise of 1° C. in temperature.

Gay-Lussac's Law of Combining Volumes. — If gases interact and form a gaseous product, the volumes of the reacting gases and the volumes of the gaseous products are to each other in very simple proportions, which can be expressed by small whole numbers.

Gibbs' Phase Rule. — $F = C + 2 - P$ F, the number of degrees of freedom of a system, is the number of variable factors (temperature, pressure and concentration) of the components, which must be arbitrarily fixed in order that the condition of the system may be perfectly defined. C, the number of the components of the system, is chosen equal to the smallest number of independently variable constituents by means of which the composition of each phase participating in the state of equilibrium can be expressed in the form of a chemical equation; the components must be chosen from among the constituents which are present when the system is in a state of true equilibrium

and which take part in that equilibrium; as components are chosen the smallest number of such constituents necessary to express the composition of each phase participating in the equilibrium, zero and negative quantities of components being permissible; in any system the number of components is definite, but may alter with changes in conditions of experiment; a qualitative but not quantitative freedom of selection of components is allowed, the choice being influenced by suitability and simplicity of application. *P*, the number of phases of the system, are the homogeneous, mechanically separable and physically distinct portions of a heterogeneous system; the number of phases capable of existence varies greatly in different systems; there can never be more than one gas or vapor phase since all gases are miscible in all proportions; a heterogeneous mixture of solid substances forms as many phases as there are substances present.

Hess' Law of Constant Heat Summation. — The amount of heat generated by a chemical reaction is the same whether reaction takes place in one step or in several steps, or all chemical reactions which start with the same original substances, and end with the same final substances, liberate the same amounts of heat, irrespective of the process by which the final state is reached.

Henry's Law. — The amount of gas which a liquid will dissolve is directly proportional to the pressure of the gas. This holds for all gases which do not unite chemically with the solvent.

The Law of Mass Action. — At a constant temperature the product of the active masses on one side of a chemical equation when divided by the product of the active masses on the other side of the chemical equation is a constant, regardless of the amounts of each substance present at the beginning of the action.

Law of Multiple Proportions. — Two elements may combine in more than one proportion by weight, but if so, the weights of one element which combine with a fixed weight of the other element, are always in a simple ratio to each other.

The Periodic Law. — The physical and chemical properties of the elements are functions of their atomic weights, and most of these properties are periodic functions of the atomic weights.

FUNDAMENTAL CHEMICAL THEORIES

A scientific hypothesis is an endeavor to form a rational mental picture of the causes which lead to a group of observed facts even though these causes may not be subject to direct proof.

A scientific theory is an hypothesis whose consequences have been so thoroughly tested by experiment that it has become generally accepted as the correct explanation for a group of facts.

The Atomic Theory. — All elementary forms of matter are composed of very small unit quantities called atoms. The atoms of a given element all have the same size and weight. The atoms of different elements have different size and weight. Atoms of the same or different elements unite with each other

to form very small unit quantities of compound substances called molecules.

Avogadro's Theory. — Equal volumes of all gases under the same conditions of temperature and pressure contain equal numbers of molecules.

The Electrolytic Dissociation or Ionization Theory. — When an acid, base or salt is dissolved in water or any other dissociating solvent, a part or all of the molecules of the dissolved substance are broken up into parts called ions, some of which are charged with positive electricity and are called cations, and an equivalent number of which are charged with negative electricity and are called anions.

Electrolytic Solution Tension Theory (or the Helmholtz Double Layer Theory). — When a metal, or any other substance capable of existing in solution as ion is placed in water or any other dissociating solvent, a part of the metal or other substances passes into solution in the form of ions, thus leaving the remainder of the metal or substances charged with an equivalent amount of electricity of opposite sign from that carried by the ions. This establishes a difference in potential between the metal and the solvent in which it is immersed.

The Electron Theory. — An atom of any element consists of a definite number of unit negative charges of electricity moving in orbits inside the atom with velocities which approach the velocity of light.

DEFINITION OF CHEMICAL TERMS

An Acid is any substance which yields hydrogen ions.

The Active Mass of a substance is the number of gram-molecular-weights per liter in solution, or in gaseous form.

Adsorption. The ability of a solid to condense gases, liquids, or dissolved substances on their surfaces is called adsorption. It is a manifestation of the force of adhesion.

An Atom is the smallest unit quantity of an element that is capable of entering into chemical combination.

A Base is any substance which yields hydroxyl ions.

A Balanced or Reversible Action is one which can be caused to proceed in either direction by suitable variation in the conditions of temperature, volume, pressure or of the quantities of reacting substances.

A Catalytic Agent is a substance which by its mere presence alters the velocity of a reaction, and may be recovered unaltered in nature or amount at the end of the reaction.

A Colligative Property is a property numerically the same for a group of substances, independent of their chemical nature.

A Constitutive Property is a property which depends on the constitution or structure of the molecule.

A Cryohydrate is the solid which separates when a saturated solution freezes. It contains the solvent and the solute in the same proportions as they were in the saturated solution.

The Combining Weight of an element or radicle is its atomic weight divided by its valence.

Eutectic, a term applied to the mixture of two or more substances which has the lowest melting point.

The Hydrogen Equivalent of a substance is the number of replaceable hydrogen atoms in 1 molecule or the number of atoms of hydrogen with which 1 molecule could react.

Hydrogen Ion Concentration or pH value is the logarithm of the reciprocal of the gram ionic hydrogen equivalents per liter i.e., $pH = \log \frac{1}{(H^+)}$ per liter. Water has a concentration of H^+ ion of 10^{-7} and of OH^- ion of 10^{-7} moles per liter or a pH value of 7. Due to hydrolysis the composition of a weak acid solution titrated against a strong base is basic and of a weak base against a strong acid is acid. A truly neutral titrated solution of a strong acid or base has the same concentration of H^+ and OH^- ions as water.

The Heat of Combustion of a substance is the amount of heat evolved by the combustion of 1 gram molecular weight of the substance.

An Ion is a charged atom or group of atoms in solution. Solutions always contain equivalent numbers of positive and negative ions.

A Molecule is the smallest unit quantity of matter which can exist by itself and retain all the properties of the original substance.

A Molar Solution contains 1 gram molecular weight of dissolved substance per liter of solution.

A Normal Solution contains 1 gram molecular weight of dissolved substance devided by the hydrogen equivalent of the substance per liter of solution.

Oxidation is any process which increases the proportion of oxygen or acid-forming element or radicle in a compound.

Reduction is any process which increases the proportion of hydrogen or base-forming elements or radicle in a compound.

A Salt is any substance which yields ions, other than hydrogen or hydroxyl ions.

The Solubility Product or precipitation value is the product of the concentrations of the ions of a substance in a saturated solution of the substance.

A METHOD OF BALANCING EQUATIONS FOR OXIDATION-REDUCTION REACTIONS

On the left-hand side of the equation write the formulæ for all the compounds entering into the reaction. On the right hand side write the formulæ for all the compounds formed in the reaction.

Determine the L. C. M. (least common multiple) of the numbers representing the changes in valence per molecule of the oxidizing and reducing agents.

The quotient obtained in dividing the L. C. M. by the number representing the valence change per molecule is the number of molecules of that compound required, or formed.

The reaction between $FeSO_4$, $KMnO_4$, and H_2SO_4 serves to illustrate. Following the rule as given above we write, $KMnO_4 + FeSO_4 + H_2SO_4 \rightarrow K_2SO_4 + MnSO_4 + Fe_2(SO_4)_3 + H_2O$.

The valence change of manganese is five, that of iron is two per molecule of $Fe_2(SO_4)_3$. The L. C. M. of these two numbers is ten.

The quotient obtained by dividing the L. C. M. by the valence change of manganese is two. Therefore two molecules of $KMnO_4$ are required. The quotient obtained by dividing the L. C. M. by the valence change of iron per molecule of $Fe_2(SO_4)_3$ is five. Five molecules of $Fe_2(SO_4)_3$ are formed. Ten molecules of $FeSO_4$ are needed. From the two molecules of $KMnO_4$ used one molecule of K_2SO_4 is formed, as well as two molecules of $MnSO_4$.

Eighteen sulfate radicals are used in forming the salts; ten of these radicals are supplied by the $FeSO_4$ used, the other eight must be supplied by the free acid. The sixteen hydrogens form eight molecules of water.

The complete equation is, therefore,

$2KMnO_4 + 10FeSO_4 + 8H_2SO_4 \rightarrow K_2SO_4 + 2MnSO_4 + 5Fe_2(SO_4)_3 + 8H_2O$.

ONE HUNDRED COMPLETED CHEMICAL EQUATIONS

1. $H_2PtCl_6 + 2KCl = 2HCl + K_2PtCl_6$
2. $K_2PtCl_6 + \text{heat} = 2KCl + Pt + 2Cl_2$
3. $KHC_4H_4O_6 + NaOH = KNaC_4H_4O_6 + H_2O$
4. $Na_2O_2 + 2H_2O = 2NaOH + H_2O_2$
5. $2KMnO_4 + 3H_2SO_4 + 5H_2O_2 = K_2SO_4 + 2MnSO_4 + 8H_2O + 5O_2$.
6. $2KI + H_2O_2 = 2KOH + I_2$
7. $2AuCl_3 + 3H_2O_2 + 6NaOH = 6NaCl + 6H_2O + 3O_2 + 2Au$
8. $MnCl_2 + 2KOH + H_2O_2 = 2KCl + H_2O + MnO_2$ (brown)
9. $2NiCl_2 + 4KOH + H_2O_2 = 4KCl + 2Ni(OH)_3$ (black)
10. $2CoCl_2 + 4KOH + H_2O_2 = 4KCl + 2Co(OH)_3$ (black)
11. $MgCl_2 + Na_2HPO_4 + NH_3 = 2NaCl + MgNH_4PO_4$
12. $2BaCl_2 + K_2Cr_2O_7 + H_2O = 2BaCrO_4 + 2HCl + 2KCl$
13. $AlCl_3 + 3KOH = 3KCl + Al(OH)_3$
14. $Al(OH)_3 + 3KOH = 3H_2O + Al(OK)_3$
15. $2AlCl_3 + 3Na_2S_2O_3 + 3H_2O = 6NaCl + 3S + 3SO_2 + 2Al(OH)_3$
16. $2CrCl_3 + 3(NH_4)_2S + 6H_2O = 6NH_4Cl + 3H_2S + 2Cr(OH)_3$
17. $CrCl_3 + 8NaC_2H_3O_2 + 4H_2O + 3Cl = 6NaCl + 8HC_2H_3O_2 + Na_2CrO_4$
18. $2CrCl_3 + 3MnO_2 + 2H_2O = 3MnCl_2 + 2H_2CrO_4$
19. $K_2Cr_2O_7 + 2KOH = H_2O + 2K_2CrO_4$
20. $K_2Cr_2O_7 + 6FeSO_4 + 7H_2SO_4 = 7H_2O + K_2SO_4 + 3Fe(SO_4)_3 + Cr_2(SO_4)_3$
21. $K_2Cr_2O_7 + 6HI + 4H_2SO_4 = K_2SO_4 + Cr_2(SO_4)_3 + 7H_2O + 6$
22. $K_2Cr_2O_7 + 14HCl = 2KCl + 2CrCl_3 + 7H_2O + 3Cl_2$
23. $FeCl_2 + 2KCN = 2KCl + Fe(CN)_2$
24. $FeCN_2 + 4KCN = K_4[Fe(CN)_6]$
25. $FeCl_3 + 3NaC_2H_3O_2 = 3NaCl + Fe(C_2H_3O_2)_x$
26. $Fe(C_2H_3O_2)_3 + 2H_2O = 2HC_2H_3O_2 + Fe(OH)_2(C_2H_3O_2)$
27. $K_4[Fe(CN)_6] + 6H_2SO_4 + 6H_2O = 2K_2SO_4 + FeSO_4 + 3(NH_4)_2SO_4 + 6CO$
28. $2MnO_2 + 8HCl = 4H_2O + 2MnCl_2 + 2Cl_2$
29. $2MnSO_4 + 5PbO_2 + 6HNO_3 = 2PbSO_4 + 3Pb(NO_3)_2 + 2H_2O + 2HMnO_4$
30. $2HMnO_4 + 14HCl = 8H_2O + 2MnCl_2 + 5Cl_2$
31. $MnSO_4 + 2Na_2CO_3 + O_2 = 2CO_2 + Na_2SO_4 + Na_2MnO_4$
32. $2KMnO_4 + 10FeSO_4 + 8H_2SO_4 = K_2SO_4 + 2MnSO_4 + 5Fe(SO_4)_3 + 8H_2O$
33. $2KMnO_4 + 3MnSO_4 + 2H_2O = K_2SO_4 + 5MnO_2 + 2H_2SO_4$
34. $NiCl_2 + 6NH_3 = Ni(NH_3)_6Cl_2$
35. $NiCl_2 + 2KCN = 2KCl + Ni(CN)_2$
36. $Ni(CN)_2 + 2KCN = K_2Ni(CN)_4$
37. $CoCl_2 + 2KNO_2 = Co(NO_2)_2 + 2KCl$
38. $Co(NO_2)_2 + 2HNO_2 = H_2O + NO + Co(NO_2)_3$
39. $Co(NO_2)_3 + 3KNO_2 = K_3Co(NO_2)_6$
40. $3Zn + 8HNO_3 = 3Zn(NO_3)_2 + 4H_2O + 2NO$
41. $Zn + 2KOH = K_2ZnO_2 + H_2$
42. $Zn(OH)_2 + 2NH_4Cl + 4NH_3 = Zn(NH_3)_6Cl_2 + 2H_2O$
43. $ZnCl_2 + 2KCN = 2KCl + Zn(CN)_2$

44. $Zn(CN)_2 + 2KCN = K_2Zn(CN)_4$
45. $3Hg + 8HNO_3 = 3Hg(NO_3)_2 + 4H_2O + 2NO$
46. $HgCl_2 + 2NH_3 = NH_4Cl + HgNH_2Cl$
47. $3HgCl_2 + 2H_2S = 4HCl + Hg_3Cl_2S_2$ (white)
48. $Hg_3Cl_2S_2 + H_2S = 2HCl + 3HgS$
49. $3Hg(NO_3)_2 + 6FeSO_4 = 2Fe(NO_3)_3 + 2Fe_2(SO_4)_3 + 3H$
50. $2HgCl + 2NH_3 = NH_4Cl + HgNH_2Cl + Hg$
51. $Hg_2(NO_3)_2 + H_2S = 2HNO_3 + HgS + Hg$
52. $Hg_2(NO_3)_2 + 2KCN = 2KNO_3 + Hg(CN)_2 + Hg$
53. $Pb(NO_3)_2 + 2KOH = Pb(OH)_2 + 2KNO_3$
54. $Pb(OH)_2 + 2KOH = K_2PbO_2 + 2H_2O$
55. $2PbCl_2 + H_2S = 2HCl + PbCl_2.PbS$ (orange)
56. $PbCl_2.PbS + H_2S = 2PbS + 2HCl$
57. $3PbS + 8HNO_3 = 3Pb(NO_3)_2 + 4H_2O + 2NO + 3S$
58. $BiCl_3 + H_2O = 2HCl + BiOCl$
59. $SnCl_2 + 2KOH = 2KCl + Sn(OH)_2$ (white ppt.)
60. $Sn(OH)_2 + 2KOH = K_2SnO_2 + 2H_2O$ (soluble)
61. $2BiCl_3 + 6KOH = 2Bi(OH)_3 + 6KCl$
62. $2Bi(OH)_3 + 3K_2SnO_2 = 3H_2O + 3K_2SnO_3 + Bi_2$ (black)
63. $3Cu + 8HNO_3 = 4H_2O + 3Cu(NO_3)_2 + 2NO$
64. $Cu + H_2SO_4 = H_2O + SO_2 + CuO$
65. $CuO + H_2SO_4 = CuSO_4 + H_2O$
66. $2CuSO_4 + 2NH_4OH = (NH_4)_2SO_4 + Cu_2SO_4 \cdot (OH)_2$
67. $Cu_2SO_4(OH)_2 + (NH_4)_2SO_4 + 6NH_3 = 2[Cu(NH_3)_4](SO_4) \cdot H_2O$ (soluble, blue)
68. $2Cu(NH_3)_4SO_4 \cdot H_2O + 9KCN = Cu_2(CN)_8NH_4 \cdot K_5 + 2K_2SO_4 + 6NH_3 + NH_4CNO$
69. $Cd(NO_3)_2 + 2KCN = 2KNO_3 + Cd(CN)_2$
70. $Cd(CN)_2 + 2KCN = K_2Cd(CN)_4$
71. $K_2Cd(CN)_4 + H_2S = 2KCN + 2HCN + CdS$
72. $H_3AsO_4 + H_2S = H_2O + S + H_3AsO_3$
73. $2H_3AsO_3 + 3H_2S = 6H_2O + As_2S_3$
74. $As_2S_3 + 3(NH_4)_2S = 2(NH_4)_3AsS_3$
75. $2(NH_4)_3AsS_3 + 6HCl = 6NH_4Cl + As_2S_3 + 3H_2S$
76. $As_2S_5 + 3(NH_4)_2S = 2(NH_4)_3AsS_4$.
77. $2(NH_4)_3AsS_4 + 6HCl = As_2S_5 + 3H_2S + 4NH_4Cl$. Antimony reactions same as arsenic
78. $3Sn + 4HNO_3 + H_2O = 3H_2SnO_3 + 4NO$
79. $SnCl_2 + H_2S = SnS + 2HCl$
80. $SnS + (NH_4)_2S_2 = (NH_4)_2SnS_3$
81. $(NH_4)_2SnS_3 + 2HCl = 2NH_4Cl + H_2S + SnS_2$
82. $SnCl_4 + 2H_2S = SnS_2 + 4HCl$
83. $SnS_2 + (NH_4)_2S = (NH_4)_2SnS_3$
84. $SnO_2 + 2KCN = 2KCNO + Sn$ (fusion)
85. $2Au + 2HNO_3 + 6HCl = 4H_2O + 2NO + 2AuCl_3$
86. $2AgNO_3 + 2KOH = 2KNO_3 + H_2O + Ag_2O$
87. $Ag_2O + 2NH_4OH = 2(AgNH_3)OH + H_2O$
88. $AgCl + 2NH_4OH = Ag(NH_3)_2Cl + 2H_2O$
89. $AgCl + 2KCN = KAg(CN)_2 + KCl$
90. $6NH_4OH + 2NH_3 + 3Cl_2 = 6H_2O + 6NH_4Cl + N_2$
91. $6NaOH + 3Cl_2 = 5NaCl + NaClO_3 + 3H_2O$
92. $H_2SO_4 + 2HI = H_2O + H_2SO_3 + I_2$

93. $H_2SO_4+8HI=4H_2O+H_2S+4I_2$
94. $2Na_2S_2O_3+I_2=2NaI+Na_2S_4O_6$
95. $H_3PO_4+12(NH_4)_2MoO_4+21HNO_3=(NH_4)_3PO_4.12MoO_3+21(NH_4)NO_3+12H_2O$
96. $(NH_4)_3PO_4.12MoO_4+24NH_4OH=(NH_4)_3PO_4+12(NH_4)_2MoO_4+12H_2O$
97. $6FeSO_4+3H_2SO_4+2HNO_3=3Fe_2(SO_4)_3+4H_2O+2NO$
98. $Fe(NO_3)_2+NO=Fe(NO_3)_2NO$
99. $KClO_3+3H_2SO_4+6FeSO_4=3Fe_2(SO_4)_3+3H_2O+KCl$
100. $Na_2SiO_3+2NH_4Cl+2H_2O=2NaCl+2NH_4OH+H_2SiO_3$

PHYSICAL TERMS, QUANTITIES AND UNITS

The following pages give general statements, definitions, C. G. S. units and definitions of units for the more important physical terms and quantities.

Mechanics

Unit of Time. — The second, 1/86400 of a mean solar day. One of the three fundamental units of the C. G. S. system.

Unit of Length. — The centimeter, 1/100 the length of the International Prototype Meter, at Paris, at zero degrees centigrade. One of the three fundamental units of the C. G. S. system. The standard in the British system is the yard, the prototype of which is kept by the British government. The United States standard yard is defined as 3600/3937 meter.

Unit of Area. — The square centimeter. The area of a square whose sides are one centimeter in length. Other units of area are similarly derived.

Unit of Volume. — The cubic centimeter, the volume of a cube whose edges are one centimeter in length. Other units of volume are derived in a similar manner.

Mass. — Quantity of matter.

Units of Mass. — The gram is 1/1000 the quantity of matter in the International Prototype Kilogram; one of the three fundamental units of the C. G. S. system. The British standard of mass is the pound, of which a standard is preserved by the government. The United States standard mass is the avoirdupois pound defined as 1/2.20462 kilogram.

Inertia. — The resistance offered by a body to a change of its state of rest or motion. A particular aspect of a mass.

Density. — Concentration of matter, measured by the mass per unit volume, expressed as grams per cubic centimeter.

Specific Gravity. — The ratio of the mass of a body to the mass of an equal volume of water at 4° C.

Angle. — The ratio between the arc and the radius of the arc.

Units of Angle. — The radian, the angle subtended by an arc equal to the radius; the degree, 1/360 part of a circumference.

Solid Angle. — Measured by the ratio of the surface of a portion of a sphere enclosed by the conical surface forming the angle, to the square of the radius of the sphere.

Unit of Solid Angle. — The steradian, the solid angle which encloses a surface on the sphere equivalent to the square of the radius.

Speed. — Time rate of motion measured by the distance moved over in unit time. Unit — one centimeter per second.

Velocity. — Time rate of motion in a fixed direction. Unit — one centimeter per second.

Angular Velocity. — Time rate of angular motion about a center. Unit — one radian per second.

Acceleration. — The time rate of change of velocity either in speed or direction measured by the change in unit time. Unit — one centimeter per second per second.

Angular Acceleration. — The time rate of change of angular velocity. Unit — one radian per second per second.

Momentum. — Quantity of motion measured by the product of mass and velocity. Unit — one gram-centimeter per second.

Angular Momentum or Moment of Momentum. — Quantity of angular motion measured by the product of the angular velocity and the moment of inertia. Unit — unnamed, its nature is expressed by $g.cm^2/sec.$

Force. — That which changes the state of rest or motion in matter, measured by the rate of change of momentum. Unit — the dyne, the force which will produce the change of velocity of one centimeter per second in a gram mass in one second.

Moment of Force or Torque. — The effectiveness of a force to produce rotation about a center, measured by the product of the force and the perpendicular distance from the line of action of the force to the center. Unit — the dyne-centimeter.

Gravitation. — The universal attraction existing between all material bodies.

Acceleration Due to Gravity. — The acceleration of a body freely falling in a vacuum. Unit — one centimeter per second per second.

Weight. — The force with which a body is attracted toward the center of the earth. The weight of any fixed mass varies according to its geographical position.

Unit of Weight. — The dyne.

Moment of Inertia. — A measure of the effectiveness of mass in rotation. In the rotation of a rigid body not only the body's mass, but the distribution of the mass about the axis of rotation determines the change in the angular velocity resulting from the action of a given torque for a given time. Moment of inertia in rotation is analogous to mass (inertia) in simple translation. The unit is $g.cm.^2$

Radius of Gyration may be defined as the distance from the axis of rotation at which the total mass of a body might be concentrated without changing its moment of inertia. The product of total mass and the square of the radius of gyration will give moment of inertia.

Period in uniform circular motion is the time of one complete revolution.

Frequency in uniform circular motion or in any periodic motion is the number of revolutions or cycles completed in unit time.

Centripetal Force. — The force required to keep a moving mass in a circular path. Centrifugal force is the name given to the outward force of a mass in rotation.

Simple Harmonic Motion. — If a point move uniformly in a circle, the motion of its projection on the diameter (or any straight line in the same plane) is simple harmonic motion.

Displacement at any instant. The distance of a vibrating or oscillating particle from its position of equilibrium or the center of the circle of reference.

Amplitude. — The maximum value of the displacement.

Phase. — The fraction of a whole period which has elapsed since the moving particle last passed through its middle position in a positive direction.

Work. — When a force acts against resistance to produce motion in a body the force is said to do work. Work is measured by the product of the force acting and the distance moved through against the resistance.

Units of Work. — The erg, a force of one dyne acting through one centimeter. The joule is 10^7 ergs.

Power. — The time rate at which work is done.

Units of Power. — The watt, one joule (ten million ergs) per second; the kilowatt is equal to 1000 watts; the horse-power 33,000 foot-pounds per minute, is equal to 746 watts.

Energy. — The capability of doing work. Units of energy the same as of work.

Potential Energy. — Energy due to position of one body with respect to another or to the relative parts of the same body.

Kinetic Energy. — Energy due to motion.

Coefficient of Friction. — The coefficient of friction between two surfaces is the ratio of the force required to move one over the other to the total force pressing the two together.

Simple Machine. — A contrivance for the transfer of energy and for increased convenience in the performance of work.

Mechanical advantage is the ratio of the resistance overcome to the force applied. Velocity ratio is the ratio of the distance through which force is applied to the distance through which resistance is overcome.

Efficiency is the ratio of the work done by a machine to the work done upon it.

Elasticity. — The property by virtue of which a body recovers from deformation produced by force.

Stress. — The force producing or tending to produce deformation in the body measured by the force applied per unit area. Unit — one dyne per square centimeter.

Strain. — The deformation resulting from a stress measured by the ratio of the change to the total value of the dimension in which the change occurred.

Modulus of Elasticity. — The stress required to produce unit strain, which may be a change of length (Young's modulus); a twist or shear (modulus of rigidity), or a change of volume (bulk modulus), expressed in dynes per square centimeter.

Limit of Elasticity. — The smallest value of the stress producing permanent alteration.

Coefficient of Restitution of two bodies on impact, the ratio of the difference in velocity before impact to the difference after impact.

Viscosity. — All liquids possess a definite resistance to change of form and many solids show a gradual yielding to forces tending to change their form. This property is called viscosity; it is expressed in dyne-seconds per cm^2 or poises.

Pressure. — Force applied to, or distributed, over a surface; measured as force per unit area. Unit — the barye, one dyne per square centimeter. The megabarye is equal to 10^6 dynes per square centimeter. Pressure is also measured by the height of the column of mercury or water which it supports.

Surface Tension. — The tension exhibited by the free surface of liquids measured in dynes per centimeter.

Heat

Temperature may be defined as the condition of a body which determines the transfer of heat to or from other bodies. The customary unit of temperature is the Centigrade degree, 1/100 the difference between the temperature of melting ice and that of water boiling under standard atmospheric pressure. The degree Fahrenheit is 1/180, and the degree Reaumur 1/80 the same difference of temperature.

The fundamental temperature scale is the absolute, thermodynamic or Kelvin scale in which the temperature measure is based on the average kinetic energy per molecule of a perfect gas. The zero of the Kelvin scale is −273.13° C. The temperature scale adopted by the International Bureau of Weights and Measures is that of the constant volume hydrogen gas thermometer. The magnitude of the degree in both these scales is defined as 1/100 the difference between the temperature of melting ice and that of boiling water at 760 mm pressure.

Heat Quantity is measured by the change of temperature produced. The unit of heat is the calorie, the quantity of heat necessary to change the temperature of one gram of water from 3.5° C. to 4.5° C. (called a small calorie). If the temperature changed involved is from 14.5 to 15.5° C., the unit is the normal calorie. The mean calorie is 1/100 the quantity of heat necessary to raise one gram of water from 0° C to 100° C. The large calorie is equal to 1000 small calories. The British thermal unit is the heat required to raise the temperature of one pound of water at its maximum density, 1° F. It is equal to 252 calories.

Coefficient of Thermal Expansion. — The coefficient of linear expansion is the ratio of the change in length per degree to the length at 0° C. The coefficient of surface expansion is two times the linear coefficient. The coefficient of volume expansion (for solids) is three times the linear coefficient. The coefficient of volume expansion for liquids is the ratio of the change in volume per degree to the volume at 0° C. The value of the

coefficient varies with temperature. The coefficient of volum expansion for a gas under constant pressure is nearly the sam for all gases and temperatures and is equal to 0.00367 for 1° C

Absolute Zero. — The temperature at which a gas would sho no pressure if the general law for gases should hold for all tem peratures. It is equal to −273.13° C. or −459.4° F.

Thermal Capacity of a Substance is the quantity of hea necessary to produce unit change of temperature in unit mas It is ordinarily expressed as calories per gram per degree Cent grade.

Specific Heat of a substance is the ratio of its thermal capacit to that of water at 15° C.

Thermal Capacity or Water Equivalent. — The total quantit of heat necessary to raise any body or system unit temperatur measured as calories per degree centigrade in the C. G. S. systen

Heat Equivalent, or Latent Heat, of Fusion. — The quantit of heat necessary to change one gram of solid to a liquid wit no temperature change.

Latent Heat of Vaporization. — The quantity of heat necessar to change one gram of liquid to vapor without change of ten perature. Both the above quantities are measured as calorie per gram.

Thermal Conductivity. — Time rate of transfer of heat b conduction, through unit thickness, across unit area for un difference of temperature. It is measured as calories per secon per square centimeter for a thickness of one centimeter and difference of temperature of 1° C.

Emissive Power or emissivity is measured by the energy rad ated from unit area of a surface in unit time for unit differen of temperature between the surface in question and surroundi bodies. For the C. G. S. system the emissive power is given ergs per second per square centimeter with the radiating surfa at 1° absolute and the surroundings at absolute zero.

Monochromatic Emissive Power is the ratio of the energy certain defined wave lengths radiated at definite temperatur to the energy of the same wave lengths radiated by a bla body at the same temperature and under the same condition

Absorptive Power for any body is measured by the fraction the radiant energy falling upon the body which is absorbed transformed into heat. This ratio varies with the character the surface and the wave length of the incident energy.

Black Body. — If, for all values of the wave length of the i cident energy, all of the energy is absorbed the body is called black body

Mechanical Equivalent of Heat is the quantity of ener which, when transformed into heat, is equivalent to unit qua tity of heat; 4.18×10^7 ergs = 1 calorie (20° C.).

Isothermal. — When a gas passes through a series of pressu and volume variations without change of temperature changes are called isothermal. A line on a pressure-volu diagram representing these changes is called an isothermal li

Adiabatic. — A body is said to undergo an adiabatic change when its condition is altered without gain or loss of heat. The line on the pressure volume diagram representing the above change is called an adiabatic line.

Critical Temperature is that temperature above which a gas cannot be liquefied by pressure alone. The pressure under which a substance may exist as a gas in equilibrium with the liquid at the critical temperature is the critical pressure.

Entropy. — A quantity depending on the quantity of heat in a body and on its temperature, which, when multiplied by any lower temperature (minimum available), gives the unavailable energy, or unavoidable waste when mechanical work is derived from the heat energy of the body.

Absolute Humidity. — Mass of water vapor present in the atmosphere measured as grams per cubic meter.

Relative Humidity. — The ratio of the quantity of water vapor present in the atmosphere to the quantity which would saturate at the existing temperature.

Wave Motion and Sound

Wave Motion. — A progressive disturbance propagated in a medium by the periodic vibration of the particles of the medium. Transverse wave motion is that in which the vibration of the particles is perpendicular to the direction of propagation. Longitudinal wave motion is that in which the vibration of the particles is parallel to the direction of propagation.

Pitch of sound is determined by the frequency or number of vibrations per second.

Intensity or loudness of a sound depends upon the energy of the wave motion. The term intensity as used in physics is measured by the energy transmitted per second through one square centimeter of surface.

Quality or timbre of a sound depends on the coexistence with the fundamental of other vibrations of various frequencies and amplitudes.

Lissajou's Figures. — The path described by a particle which is sumultaneously displaced by two simple harmonic motions at right angles, when the periods of the two motions are in the ratio of two small whole numbers, shows a variety of characteristic curves called Lissajou's figures.

Beats. — Two tones of slightly different frequencies sounded together interfere to give a sound of regularly varying intensity. The number of beats per second is the difference in frequency of the two tones.

Static Electricity

Unit Quantity of electricity or charge is the quantity which, when concentrated at a point and placed at unit distance from an equal and similarly concentrated quantity, is repelled with unit force. If the distance is one centimeter and the force of repulsion one dyne and the surrounding medium a vacuum,

we have the electrostatic unit of quantity. The coulomb = 3×10^9 electrostatic units.

Line of Force. — A line such that its direction at every point is the same as the direction of the force which would act on a small positive charge placed at that point. A line of force is defined as starting from a positive charge and ending on a negative charge.

Conductors. — A class of bodies which are incapable of supporting electric strain. A charge given to a conductor spreads to all parts of the body.

Dielectrics or Insulators or Non-Conductors. — A class of bodies supporting an electric strain. A charge on one part of a non-conductor is not communicated to any other part.

Electric Surface Density. — Quantity of electricity per unit area.

Intensity of Electric Field is measured by the force exerted on unit charge. Unit field intensity is the field which exerts the force of one dyne on unit positive charge.

Electric Potential at any point is measured by the work necessary to bring unit positive charge from an infinite distance. Difference of potential between two points is measured by the work necessary to carry unit positive charge from one to the other. If the work involved is one erg we have the electrostatic unit of potential.

Capacity is measured by the charge which must be communicated to a body to raise its potential one unit. Electrostatic unit capacity is that which requires one electrostatic unit of charge to raise its potential one electrostatic unit. The farad = 9×10^{11} electrostatic units.

Specific Inductive Capacity. — The ratio of the capacity of a condenser with a given substance as dielectric to the capacity of the same condenser with air or a vacuum as dielectric is called the specific inductive capacity.

Magnetism

Unit Magnetic Pole or Quantity of Magnetism. — Two unit quantities of magnetism concentrated at points unit distance apart in a vacuum repel each other with unit force. If the distance involved is one centimeter and the force one dyne, the quantity of magnetism at each point is one C. G. S. unit of magnetism.

Surface Density of Magnetism. — Quantity of magnetism per unit area.

Magnetic Moment of a magnet is measured by the torque experienced when it is at right angles to a uniform field of unit intensity. The value of the magnetic moment is given by the product of the magnetic pole strength by the distance between the poles. Unit magnetic moment is that possessed by a magnet formed by two poles of opposite sign and of unit strength, one centimeter apart.

Intensity of Magnetization is given by the quotient of the

magnetic moment of a magnet by its volume. Unit intensity of magnetization is the intensity of a magnet which has unit magnetic moment per cubic centimeter.

Magnetic Line of Force is a line which at every point has the direction of the magnetic force at that point.

Magnetic Field Intensity or Magnetizing Force is measured by the force acting on unit pole. Unit field intensity, the gauss, is that field which exerts a force of one dyne on unit magnetic pole. The field intensity is also specified by the number of lines of force intersecting unit area normal to the field, equal numerically to the field strength in gauss. Magnetizing force is measured by the space rate of variation of magnetic potential and as such its unit may be the gilbert per centimeter.

Magnetic Potential or Magnetomotive Force at a point is measured by the work required to bring unit positive pole from an infinite distance (zero potential) to the point. The unit is the gilbert, that magnetic potential against which an erg of work is done when unit magnetic pole is transferred.

Magnetic Flux through any area perpendicular to a magnetic field is measured as the product of the area by the field strength. The unit of magnetic flux, the maxwell, is the flux through a square centimeter normal to a field of one gauss.

Magnetic Induction resulting when any substance is subjected to a magnetic field is measured as the magnetic flux per unit area taken perpendicular to the direction of the flux. The unit is the maxwell per square centimeter or its equivalent, the gauss.

Magnetic Permeability is a property of materials modifying the action of magnetic poles placed therein and modifying the magnetic induction resulting when the material is subjected to a magnetic field or magnetizing force. The permeability of a substance may be defined as the ratio of the magnetic induction in the substance to the magnetizing field to which it is subjected. The permeability of a vacuum is unity.

Magnetic Susceptibility is measured by the ratio of the intensity of magnetization produced in a substance to the magnetizing force or intensity of field to which it is subjected. The susceptibility of a substance will be unity when unit magnetic intensity is produced by a field of one gauss.

Magnetic Reluctance for any magnetic circuit is measured by the ratio of the magnetomotive force or magnetic potential to the flux produced in the circuit. The unit of reluctance, the oersted, is the reluctance of a cylinder of one square centimeter cross section and one centimeter length taken in a vacuum.

Permeance, the reciprocal of reluctance. Unit permeance is the permeance of a cylinder one square centimeter cross section and one centimeter length taken in a vacuum.

Reluctivity or specific reluctance is the reciprocal of permeability. The reluctivity of empty space is taken as unity.

Paramagnetic bodies are those which tend to set the longest dimension parallel to the magnetic field. The permeability of a paramagnetic substance is greater than unity. Iron is paramagnetic.

Diamagnetic bodies tend to set the longest dimension across the magnetic field. The permeability of a diamagnetic substance is less than unity.

Hysteresis. — The magnetization of a sample of iron or steel due to a magnetic field which is made to vary through a cycle of values, lags behind the field. This phenomenon is called hysteresis.

Declination. — The angle between the vertical plane containing the direction of the earth's field at any point and a plane containing the geographic north and south meridian.

Dip. — The angle measured in a vertical plane between the direction of the earth's magnetic field and the horizontal.

Current Electricity

Electric Current. — The rate of transfer of electricity. The transfer at the rate of one electrostatic unit of electricity in one second is the electrostatic unit of current. The electromagnetic unit of current is a current of such strength that one centimeter of the wire in which it flows is pushed sideways with a force of one dyne when the wire is at right angles to a magnetic field of unit intensity. The practical unit of current is the ampere, a transfer of one coulomb per second, which is one tenth the electromagnetic unit. The international ampere is the unvarying electric current which when passed through a solution of silver nitrate in accordance with certain specifications, deposits silver at the rate of 0.00111800 gram per second. The international ampere is equivalent to 0.99991 absolute ampere.

Quantity. — The electromagnetic unit of quantity may be defined as that transferred by unit current in unit time. The quantity transferred by one ampere in one second is the coulomb, the practical unit.

Electromotive Force is defined as that which causes a flow of current. The electromotive force of a cell is measured by the maximum difference of potential between its plates. The electromagnetic unit of potential difference is that against which one erg of work is done in the transfer of electromagnetic unit quantity. The volt is that potential difference against which one joule of work is done in the transfer of one coulomb. One volt is equivalent to 10^8 electromagnetic units of potential. The international volt is the electrical pressure which when steadily applied to a conductor whose resistance is one international ohm will cause a current of one international ampere to flow. The international volt = 1.00043 absolute volts. The electromotive force of a Weston standard cell is 1.0183 at 20° C.

Resistance is property of conductors depending on their dimensions material and temperature which determines the current produced by a given difference of potential. The practical unit of resistance, the ohm, is that resistance through which a difference of potentia of one volt will produce a current of one ampere. The international ohm is the resistance offered to an unvarying current by a column of mercury at 0° C.

4.4521 grams in mass, of constant cross sectional area and 06.300 centimeters in length.

Conductance, the reciprocal of resistance, is measured by he ratio of the current flowing through a conductor to the ifference of potential between its ends. The practical unit of onductance, the mho, is the conductance of a body through vhich one ampere of current flows when the potential difference s one volt. The conductance of a body in mho is the reciprocal f the value of its resistance in ohms.

Conductivity is measured by the quantity of electricity trans-erred across unit area, per unit potential gradient per unit time.

Resistivity or Specific Resistance, the reciprocal of conduc-ivity, is measured by the resistance of a body of the substance of nit cross section and of unit length at 0° C.

Temperature Resistance Coefficient. — The ratio of the hange of resistance in a wire due to a change of temperature f 1° C. to its resistance at 0° C.

Induction. — Any change in the intensity or direction of a nagnetic field causes an electromotive force in any conductor n the field. The induced electromotive force generates an nduced current if the conductor forms a closed circuit.

Self-Inductance. — The change in magnetic field due to the ariation of a current in a conducting circuit causes an induced lectromotive force in the circuit itself. This phenomenon is nown as self-induction. It is measured as electromotive force roduced in a conductor by unit rate of variation of the current hrough it. Units of self-inductance are the centimeter (electro tatic) and the henry, which is equal to 10^9 centimeters of in-luctance.

Mutual Inductance. — A change of current in a conductor is ccompanied by a change of magnetic field which induces an lectromotive force in a neighboring circuit. The mutual in-luction is measured by the electromotive force induced in one ircuit by unit rate of variation of current in the other. Units, s of self-inductance.

Thermoelectric Power is measured by the electromotive orce produced by a thermocouple for unit difference of tem-erature between the two junctions. It varies with the average emperature and is usually expressed in microvolts per degree C. It is customary to list the thermoelectric power of the arious metals with respect to lead.

Light

Luminous Flux. — The total visible energy emitted by a ource per unit time is called the total luminous flux from the ource. The unit of flux, the lumen, is the flux emitted in unit olid angle (steradian) by a point source of one candle luminous ntensity. A uniform point source of one candle intensity thus mits 4π lumens.

Visibility is measured by the ratio of the luminous flux in umens to the total radiant energy in ergs per second or in watts.

Luminous Intensity or candle-power is the property of source of emitting luminous flux and may be measured by th luminous flux emitted per unit solid angle. The accepted un of luminous intensity is the international candle. The hefn unit, which is equivalent to 0.9 international candles, is the i tensity of a lamp of specified design burning amyl acetate, calle the Hefner lamp.

The mean horizontal candle-power is the average intensit measured in a horizontal plane passing through the sourc The mean spherical candle-power is the average candle-pow measured in all directions and is equal to the total luminou flux in lumens divided by 4π.

Illumination on any surface is measured by the luminou flux incident on unit area. The units in use are: the lux, or lumen per square meter; the phot, one lumen per square cent meter and the lumen per square foot. Since at unit distanc from a point source of unit intensity the illumination is unit unit illumination may be defined as that produced by unit sourc at unit distance, hence the meter-candle or candle-meter whic is equal to the lux and the foot-candle equivalent to one lume per square foot.

Brightness is measured by the flux emitted per unit emissiv area as projected on a plane normal to the line of sight. The un of brightness is that of a perfectly diffusing surface giving ou one lumen per square centimeter of projected surface and called the lambert. The millilambert (0.001 lambert) is a mor convenient unit.

Reflection Coefficient is the ratio of the light reflected from surface to the total incident light. The coefficient may refer t diffuse or to specular reflection. In general it varies with th angle of incidence and with the wave length of the light.

Index of Refraction for any substance is the ratio of th velocity of light in a vacuum to its velocity in the substanc It is also the ratio of the sine of the angle of incidence to th sine of the angle of refraction. In general, the index of re fraction for any substance varies with the wave length of th refracted light.

Minimum Deviation. — The deviation or change of directio of light passing through a prism is a minimum when the angl of incidence is equal to the angle of emergence.

Principal Focus of a lens or spherical mirror is the point c convergence of light coming from a source at an infinite distanc

Conjugate Foci. — Under proper conditions light divergen from a point on or near the axis of a lens or spherical mirror focused at another point. The point of convergence and th position of the source are conjugate foci.

Nodal Points. — Two points on the axis of a lens such that ray entering the lens in the direction of one, leaves as if fro the other and parallel to the original direction.

Spherical Aberration. — When large surfaces of spherica mirrors or lenses are used the light divergent from a poin

source is not exactly focused at a point. The phenomenon is known as spherical aberration. For axial pencils the error is known as axial spherical aberration; for oblique pencils, coma.

Chromatic Aberration. — Due to the difference in the index of refraction for different wave lengths, light of various wave lengths from the same source cannot be focused in a point by a simple lens. This is called chromatic aberration.

Achromatic. — A term applied to lenses signifying their more or less complete correction for chromatic aberration.

Astigmatism is an error of spherical lenses peculiar to the formation of images by oblique pencils. The image of a point when astigmatism is present will consist of two focal lines at right angles to each other and separated by a measurable distance along the axis of the pencil. The error is not eliminated by reduction of aperture as is spherical aberration.

Magnifying Power of an optical instrument is the ratio of the angle subtended by the image of the object seen through the instrument to the angle subtended by the object when seen by the unaided eye. In the case of the microscope or simple magnifier the object as viewed by the unaided eye is supposed to be at a distance of 25 cms. (10 ins.)

Resolving Power of a telescope or microscope is indicated by the minimum separation of two objects for which they appear distinct and separate when viewed through the instrument.

Angular Aperture of an objective is the largest angular extent of wave surface which it can transmit.

Numerical Aperture is the sine of half the angular aperture, used as a measure of the optical power of the objective.

Dispersion. — The difference between the index of refraction of any substance for any two wave lengths is a measure of the dispersion for these wave lengths, called the coefficient of dispersion.

Diffraction. — If the light source were a point, the shadow of any object would have its maximum sharpness; a certain amount of illumination, however, would be found within the geometrical shadow due to the diffraction of the light at the edge of the object.

Polarized Light. — Light which exhibits different properties in different directions at right angles to the line of propagation is said to be polarized. Specific rotation is the power of liquids to rotate the plane of polarization. It is stated in terms of specific rotation or the rotation in degrees per decimeter per unit density.

PHYSICAL LAWS AND FORMULÆ

On the following pages will be found a collection of the more important laws and equations of physics. Definitions and units will be found in the preceding table.

Unless otherwise specified, the symbol g in the following formulæ refers to the acceleration due to gravity.

Formulæ for capacity, inductance and high frequency resistance as used in radio work are given in a separate collection immediately following.

Mechanics

Composition of Vectors. — If the angle between two vectors is A, and their magnitudes a and b, their resultant,

$$c = \sqrt{a^2 + b^2 + 2ab \cos A}.$$

Triangle or Polygon of Forces. — If three or more forces acting on the same point are in equilibrium, the vectors representing them form, when added, a closed figure.

Velocity. — If s is space passed over in time t, the velocity,

$$v = \frac{s}{t}.$$

Uniformly Accelerated Motion. — If v_0 is the initial velocity v_t the velocity after time t, the acceleration,

$$a = \frac{v_t - v_0}{t}.$$

The velocity after time t,

$$v_t = v_0 + at.$$

Space passed over in time t,

$$s = v_0 t + \tfrac{1}{2}at^2.$$

Velocity after passing over space s,

$$v_s = \sqrt{v_0^2 + 2as}.$$

Space passed over in the nth second,

$$s = v_0 + \tfrac{1}{2}a(2n - 1).$$

In the above and following similar equations the values of the space, velocity, and acceleration must be substituted in the same system. For space in cm, velocity will be in cm per sec. and acceleration in cm per sec.

Falling Bodies. — Symbols as for uniformly accelerated motion except that $v_0 = 0$ and g is the acceleration due to gravity. The above formulæ become, — air resistance neglected,

$$v_t = gt, \quad s = \tfrac{1}{2}gt^2, \quad v_s = \sqrt{2gs}.$$

Bodies Projected Vertically Upward. — If v is the velocity of projection, the time to reach greatest height, neglecting the resistance of the air,

$$t = \frac{v}{g}.$$

Greatest height,

$$h = \frac{v^2}{2g}.$$

Projectiles. — For bodies projected with velocity v at an angle α with the horizontal, the time to highest point of flight,

$$t = \frac{v \sin \alpha}{g}.$$

Total time of flight,

$$T = \frac{2v \sin \alpha}{g}.$$

Maximum height,

$$h = \frac{v^2 \sin^2 \alpha}{2g}.$$

Horizontal range,

$$R = \frac{v^2 \sin 2\alpha}{g}.$$

In the above equations the resistance of the air is neglected.

Angular Velocity. — If the angle described in time t is θ, the angular velocity,

$$\omega = \frac{\theta}{t}.$$

θ in radians and t in seconds gives ω in radians per second.

Angular Acceleration. — If the initial angular velocity is ω_0, and the velocity after time t is $= \omega_t$, the angular acceleration,

$$A = \frac{\omega_t - \omega_0}{t}.$$

The angular velocity after time t,

$$\omega_t = \omega_0 + At.$$

The angle swept out in time t,

$$\theta = \omega_0 t + \tfrac{1}{2} A t^2.$$

The angular velocity after movement through the arc θ,

$$\omega = \sqrt{\omega_0^2 + 2A\theta}.$$

In the above equations, for angular displacement in radians, angular velocity will be in radians per second and angular acceleration in radians per second per second.

Newton's Laws of Motion.

I. Every body continues in its state of rest or of unifor motion in a straight line except in so far as it may be compell to change that state by the action of some outside force.

II. Change of motion is proportional to force applied a takes place in the direction of the line of action of the force.

III. To every action there is always an equal and opposi reaction.

Momentum. — A mass m moving with velocity v has a m mentum,

$$M = mv.$$

Angular momentum of a mass whose moment of inertia is rotating with angular velocity ω, is

$$I\omega.$$

Change in Momentum. — If a mass m has its velocity chang from v_1 to v_2 by the action of a force F for a time t,

$$mv_2 - mv_1 = Ft.$$

Conservation of Momentum. — If two bodies of masses m and m_2 before impact have velocities v_1 and v_2 and after impa velocities u_1 and u_2,

$$m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2.$$

Force. — For a mass m and an acceleration a,

$$F = ma.$$

If m is substituted in grams and a in cm per sec^2, F will b given in dynes.

Pressure. — The pressure due to a force F distributed ov an area A,

$$P = \frac{F}{A}.$$

Moment of Force or Torque. — If a force F acts to produ rotation about a center at a distance d from the line in whi the force acts, the force has a torque,

$$L = Fd.$$

Moment of Inertia. — If m_1, m_2, m_3 etc. represent the mass of infinitely small particles of a body; r_1, r_2, r_3 etc. their r spective distances from an axis of rotation, the moment of inert about this axis will be,

$$I = (m_1r_1^2 + m_2r_2^2 + m_3r_3^2 + \ldots)$$

or

$$I = \Sigma(mr^2).$$

Gravitation. — The force of attraction between two masse m and m', separated by a distance r, k being the constant gravitation,

$$F = k\frac{mm'}{r^2}.$$

(If m and m' are given in grams, and r in centimeters, F will be in dynes if $k = 6.658 \times 10^{-8}$.)

Weight of mass m, where g is the acceleration due to gravity,

$$W = mg.$$

The weight will be given in dynes when m is in grams and g in cm per sec^2.

Acceleration Due to Gravity at any Latitude and Elevation. If ϕ is the latitude and H the elevation in centimeters the acceleration in C.G.S. units is,

$$g = 980.616 - 2.5928 \cos 2\phi + 0.0069 \cos^2 2\phi - 3.086 \times 10^{-6} H.$$

(Helmert's equation.)

Uniform Circular Motion. — If r is the radius of a circle, s the linear speed in the arc, ω the angular velocity and T the period or time of one revolution,

$$\omega = \frac{s}{r} = \frac{2\pi}{T}.$$

The acceleration toward the center is

$$a = \frac{s^2}{r} = \omega^2 r = \frac{4\pi^2 r}{T^2}.$$

The centrifugal force for a mass m,

$$F = \frac{ms^2}{r} = m\omega^2 r = \frac{4\pi^2 mr}{T^2}.$$

In the above equations ω will be in radians per second and a in cm per sec.^{2} if r is in cm, s in cm per sec. and T in sec. F will will be in dynes if mass is in grams and other units as above.

Application to the Solar System. — If M is the mass of the sun, G the constant of gravitation, P the period of the planet, and r the distance of the planet from the sun, then the mass of the sun

$$M = \frac{4\pi^2 r^3}{GP^2} \quad (G = 6.657 \text{ for C.G.S. units.})$$

If P is the period and r the distance of a satellite revolving around the planet, the above expression for M gives the mass of the planet. The formula is written on the assumption that the orbit of the planet or satellite is circular, which is only approximately true.

Kepler's Laws.

I. The planets move about the sun in ellipses, at one focus of which the sun is situated.

II. The radius vector joining each planet with the sun describes equal areas in equal times.

III. The cubes of the mean distances of the planets from the sun are proportional to the squares of their times of revolution about the sun.

Simple Harmonic Motion. — If r is the radius of the refer-

ence circle, ω the angular velocity of the point in the circle, the angular displacement at the time t after the particle passe the mid-point of its path, the linear displacement,

$$x = \text{r} \sin \theta = r \sin \omega t.$$

The velocity at the same instant,

$$v = r\omega \cos \theta = \omega\sqrt{r^2 - x^2}.$$

The acceleration,

$$a = -\omega^2 x.$$

The force for a mass m,

$$F = -m\omega^2 x = -\frac{4\pi^2 mx}{T^2}.$$

The period

$$T = 2\pi\sqrt{\frac{x}{a}}.$$

In the above equations the C. G. S. system calls for x and r i cm, v in cm per sec., a in cm per sec.^{2}, T in sec., m in grams, in radians, and ω in radians per sec.

The Pendulum. — For a simple pendulum of length l, for small amplitude, the period,

$$T = 2\pi\sqrt{\frac{l}{g}}, \text{ or } g = 4\pi^2\frac{l}{T^2}.$$

T will be given in seconds if l is in cm and g in cm per sec^2.

For a sphere suspended by a wire of negligible mass wher d is the distance from the knife edge to the center of the spher whose radius is r, the length of the equivalent simple pendulum

$$l = d + \frac{2r^2}{5d}.$$

If the period is P for an arc θ, the time of vibration in a infinitely small arc is approximately,

$$T = \frac{P}{1 + \frac{1}{4}\sin^2\frac{\theta}{4}}.$$

For a compound pendulum, if a body of mass m be suspende from a point about which its moment of inertia is I with it center of gravity a distance h below the point of suspensio the period,

$$T = 2\pi\sqrt{\frac{I}{mgh}}.$$

Foucault's Pendulum. — The rate of rotation in degrees p hour of a line on the surface of the earth relative to the plan of a Foucault's pendulum at latitude ϕ is,

$$\omega = 15 \sin \phi.$$

Work. — If a force F act through a space s, the work done is

$$W = Fs.$$

Work will be given in ergs if F is in dynes and s in cm.

Work done in rotation. If a torque L dyne-cm acts through an angle θ radians, the work done in ergs is,

$$W = L\theta.$$

Power. — If an amount of work W is done in time t the power or rate of doing work is,

$$P = \frac{W}{t} = \frac{Fs}{t}.$$

Power will be obtained in watts if W is expressed in joules (10^7 ergs) and t in sec.

Energy. — The potential energy of a mass m, raised through a distance h, where g is the acceleration due to gravity, is

$$E = mgh.$$

The kinetic energy of mass m, moving with a velocity v, is

$$E = \tfrac{1}{2}mv^2.$$

Energy will be given in ergs if m is in grams, g in cm per sec.^{2}, h in cm and v in cm per sec.

Kinetic Energy of Rotation. — If a mass whose moment of inertia about an axis is I, rotates with angular velocity ω about this axis, the kinetic energy of rotation will be,

$$E = \tfrac{1}{2}I\omega^2.$$

Energy will be given in ergs if I is in g.cm^2 and ω in radians per sec.

Conservation of Energy. — In every modification of a material system not affected by forces foreign to the system the sum of its potential and kinetic energies remains constant.

Friction. — If F is the force required to move one surface over another and W, the force pressing the surfaces together, the coefficient of friction,

$$k = \frac{F}{W}.$$

Simple Machines. — If a force f applied to a machine through a distance S results in a force F exerted by the machine through a distance s, neglecting friction,

$$fS = Fs.$$

The theoretical mechanical advantage or velocity ratio in the above case is

$$\frac{S}{s}.$$

Actually the force obtained from the machine will have a smaller value than will satisfy the equation above. If F' be the actual force obtained, the practical mechanical advantage will be

$$\frac{F'}{f}.$$

The efficiency of the machine,

$$E = \frac{Fs'}{fS}.$$

Mass by Weighing on a Balance with Unequal Arms. — If W_1 is the value for one side, W_2 the value for the other, the true mass,

$$W = \sqrt{W_1 W_2}.$$

Sensitiveness of a Balance. — If w is the weight of the beam, h the distance of the center of gravity below the knife edge, a the length of the balance arms and x a small mass added to one pan, the deflection θ produced is given by

$$\tan \theta = \frac{ax}{wh}.$$

Hooke's Law. — Within the elastic limit of any body the ratio of the stress to the strain produced is constant.

Elastic Coefficients

Young's modulus by stretching. — If an elongation s is produced by the weight of the mass m, in a wire of length l, and radius r, the modulus,

$$M = \frac{mgl}{\pi r^2 s}.$$

Young's modulus by bending, bar supported at both ends. If a flexure s is produced by the weight of mass m, added midway between the supports separated by a distance l, for a rectangular bar with vertical dimensions of cross-section a and horizontal dimension b, the modulus is,

$$M = \frac{mgl^3}{4sa^3b}.$$

For a cylindrical bar of radius r,

$$M = \frac{mgl^3}{12\pi r^4 s}.$$

For a bar supported at one end. In the case of a rectangular bar as described above,

$$M = \frac{4mgl^3}{sa^3b}.$$

For a round bar supported at one end,

$$M = \frac{4mgl^3}{3\pi r^4 s}.$$

Modulus of Rigidity. — If a couple C $(= mgx)$ produces a twist of θ radians in a bar of length l and radius r, the modulus is

$$M = \frac{2Cl}{\pi r^4 \theta}.$$

The substitution in the above formulæ for the elastic coefficients of m in grams, g in cm per sec., l, a, b, and r in cm, s in cm^2, and C in dyne-cm will give moduli in dynes per cm^2.

Coefficient of Restitution. — Two bodies moving in the same straight line, with velocities v_1 and v_2 respectively, collide and after impact move with velocities v_3 and v_4. The coefficient of restitution is

$$C = \frac{v_4 - v_3}{v_2 - v_1}.$$

Viscosity. — Flow of liquids through a tube; where l is the length of the tube, r its radius, the difference of pressure at the ends, η the coefficient of viscosity, the volume escaping per second,

$$v = \frac{\pi p r^4}{8 l \eta}. \qquad \text{(Poiseuille.)}$$

The volume will be given in cm^3 per second if l and r are in cm, p in dynes per cm^2 and η in poises or dyne-seconds per cm^2.

Stokes' Law gives the rate of fall of a small sphere in a viscous fluid. When a small sphere falls under the action of gravity through a viscous medium it ultimately acquires a constant velocity,

$$V = \frac{2ga^2(d_1 - d_2)}{9\eta}.$$

where a is the radius of the sphere, d_1 and d_2 the densities of the sphere and the medium respectively, and η the coefficient of viscosity. V will be in cm^3 per sec. if g is in cm per $sec.^2$, a in cm, d_1 and d_2 in g per cm^3 and η in dyne-sec. per cm^2 or poises.

Diffusion. — If the concentration (mass of solid per unit volume of solution) at one surface of a layer of liquid is d_1, and at the other surface d_2, the thickness of the layer h and the area under consideration A, then the mass of the substance which diffuses through the cross-section A in time t is,

$$m = KA\frac{(d_2 - d_1)t}{h}.$$

where K is the coefficient of diffusion. *See table Diffusion.*

Surface Tension. — The total force along a line of length l on the surface of a liquid whose surface tension is T,

$$F = lT.$$

Capillary Tubes. — If a liquid of density d rises a height h in a tube of internal radius r the surface tension is,

$$T = \frac{rhdg}{2}.$$

The tension will be in dynes per cm if r and h are in cm d in g per cm^3 and g in cm per sec^2.

Pressure in dynes per cm^2 due to surface tension on a drop o radius r cm for a liquid whose surface tension is T dynes pe cm,

$$P = \frac{2T}{r}.$$

For a bubble of mean radius r cm, $P = \frac{4T}{r}$.

Values of T will be found in tables in another part of thi volume.

Hydrostatic pressure at a distance h from the surface of fluid of density d,

$$P = hdg.$$

The total force on an area A due to hydrostatic pressure,

$$F = PA = Ahdg.$$

Force in dynes and pressure in dynes per cm^2 will be given h is in cm, d in g per cm^3 and g in cm per sec^2.

Pascal's Law. — Pressure exerted at any point upon the mas of a liquid is transmitted undiminished in all directions.

Archimedes Principle. — A body wholly or partly immerse in a fluid is buoyed up by a force equal to the weight of th fluid displaced. A body of volume V cm^3 immersed in a flui of density d grams per cm^3 is buoyed up by a force in dynes,

$$F = dgV.$$

A floating body displaces its own weight of liquid.

Velocity of Efflux of a Liquid. — If h is the distance fro the opening to the free surface of the liquid, the velocity efflux is

$$V = \sqrt{2gh}.$$

The above is the theoretical discharge velocity disregardin friction and the shape of orifice. For water issuing through circular opening with sharp edges of area, A, the volume di charged per second is given approximately by,

$$Q = 0.62A\sqrt{2gh}.$$

Bernoulli's Theorem. At any point in a tube through whic a liquid is flowing the sum of the pressure energy, potenti energy, and kinetic energy is a constant. If p is pressure; height above a reference plane; d, density of the liquid, and velocity of flow,

$$p + hdg + \tfrac{1}{2}dv^2 = \text{a constant}.$$

Diminution of Pressure at the Side of a Moving Stream. — If a fluid of density d moves with a velocity v the diminutio of pressure due to the motion is (neglecting viscosity),

$$p = \tfrac{1}{2}dv^2.$$

Boyle's Law. — For a perfect gas, changing from pressure p and volume v to pressure p' and volume v' without change of temperature,

$$pv = p'v'.$$

Altitudes with the Barometer. — If b_1 and b_2 denote the corrected barometer readings at two stations, t the mean of the temperatures t_1 and t_2 of the air at the two stations, e_1 and e_2, the tension of water vapor at the two stations, h the mean height above sea level, ϕ the latitude, then the difference in elevation in centimeters is

$$H = 1{,}843{,}000\ (\log b_1 - \log b_2)(1 + 0.00367t)(1 + 0.0026 \cos 2\phi + 0.00002h + \tfrac{3}{8}k),$$

where

$$k = \tfrac{1}{2}\left(\frac{e_1}{b_1} + \frac{e_2}{b_2}\right).$$

An approximate formula, sufficient for differences not over 1000 meters is

$$H = 1{,}600{,}000\ \frac{b_1 - b_2}{b_1 + b_2}(1 + 0.004t).$$

Heat

Thermal Expansion. — If l_0 is the length at 0° C., α the coefficient of linear expansion, the length at t_0 C. is,

$$l_t = l_0(1 + \alpha t).$$

General Formula for Thermal Expansion. — The rate of thermal expansion varies with the temperature. The general equation giving the magnitude m_t (length or volume) at a temperature t, where m_0 is the magnitude at 0° C., is

$$m_t = m_0(1 + \alpha t + \beta t^2 + \gamma t^3 \ldots .)$$

where α, β, γ, etc., are empirically determined coefficients.

Volume expansion. If V represents volume and β the coefficient of expansion,

$$V_t = V_0(1 + \beta t).$$

For solids, $\beta = 3\alpha$ (approximately).

Expansion of Gases, Charles' Law or Gay-Lussac's Law. The volume of a gas at constant pressure increases proportionally to the absolute temperature. If V_1 and V_2 are volumes of the same mass of gas at absolute temperatures T_1 and T_2,

$$\frac{V_1}{V_2} = \frac{T_1}{T_2}.$$

For an original volume V_0 at 0° C. the volume at t° C. (at constant pressure) is

$$V_t = V_0(1 + 0.00367t).$$

General Law for Gases.

$$p_t v_t = p_0 v_0 \left(1 + \frac{t}{273}\right),$$

where p_0, v_0, p_t, v_t represent the pressure and volume at and $t°$ C.

The law may also be expressed,

$$pv = RT$$

where T is the absolute temperature and R a constant depen ing only on the units of pressure, volume and temperatu For volume in cm^3, pressure in dynes per cm^2 and temperatu in Centigrade degrees on the absolute scale $R = 8.3156 \times 10$

Reduction of a Gas Volume to 0° C., 760 mm. Pressure. If V is the original volume of a gas at temperature t and pressu H the volume at 0° C. and 760 mm. pressure will be,

$$V_0 = \frac{V}{(1 + \alpha t)} \frac{H}{760}.$$

If d is the original density the density at 0° C. and 760 m pressure will be,

$$d_0 = d(1 + \alpha t)\frac{760}{H},$$

$$\alpha = 0.00367 \text{ approximately.}$$

Avogadro's Law. — Equal volumes of different gases at t same pressure and temperature contain the same number molecules.

Dalton's Law. The pressure of a mixture of several gas in a given space is equal to the sum of the pressures which ea gas would exert if confined by itself in that space.

Van der Waal's Variation of Boyle's Law.

$$(p + \frac{a}{v^2})(v - b) = RT$$

where p and v are the pressure and volume at any constant te perature and a and b are constants. R is the gas constant a T the absolute temperature. For values of R, a and b see tabl

Kinetic Theory, Expression for Pressure.

$$P = \tfrac{1}{3} N m v^2$$

where N is the number of molecules in unit volume, m t mass of each molecule and v^2 the mean square of the veloc of the molecules.

Gas Thermometer. — Where P_0, P_s, and P_x represent t total pressures with the bulb at 0° C., at the boiling-point water and at the unknown temperature respectively, t_s t temperature of steam and t_x the unknown temperature,

$$t_x = t_s \frac{P_x - P_0}{P_s - P_0}$$

(approximately). The total pressure on the gas in the b is the sum of barometric pressure at the time and that measu by the manometer.

Dulong and Petit's Law of Thermal Capacity. — For simple substances the atoms all have approximately the same thermal capacity. The product of the specific heat by the atomic weight is a constant, — about 6.38.

Specific Heat. — If a quantity of heat H calories is necessary to raise the temperature of m grams of a substance from t_1 to t_2° C., the specific heat,

$$s = \frac{H}{m(t_2 - t_1)}.$$

Specific Heat by the Method of Mixtures. — Where a mass m_1 of the substance is heated to a temperature t_1, then placed in a mass of water m_2 at a temperature t_2 contained in a calorimeter with stirrer (of same material) of mass m_3, specific heat of the calorimeter c, v the volume of the immersed portion of the thermometer, t_3 the final temperature, the specific heat.

Black's Ice Calorimeter. — If a body of mass m and temperature t melts a mass m' of ice, its temperature being reduced to 0° C., the specific heat of the substance is,

$$s = \frac{80.1m'}{mt}.$$

Bunsen's Ice Calorimeter.—A body of mass m at temperature t causes a motion of the mercury column of l centimeters in a tube whose volume per unit length is v. The specific heat is

$$s = \frac{884lv}{mt}.$$

Conduction of Heat.—If the two opposite faces of a cube of a substance are maintained at temperatures t_1 and t_2, the heat conducted across the cube of section a and thickness d in a time T will be,

$$Q = K\frac{(t_2 - t_1)aT}{d}.$$

K is a constant depending on the nature of the substance, designated as the specific heat conductivity. K is usually given for Q in calories, t_1 and t_2 in °C, a in cm², T in sec., and d in cm. *See table Heat Conductivity.*

First Law of Thermodynamics. — When mechanical work is transformed into heat or heat into work the amount of work is always equivalent to the quantity of heat.

Second Law of Thermodynamics. — It is impossible by any continuous self-sustaining process for heat to be transferred from a colder to a hotter body.

Stefan-Boltzman Law of Radiation. — The energy radiated in unit time by a black body is given by, $E = K(T^4 - T_0^4)$, where T is the absolute temperature of the body, T_0 the absolute temperature of the surroundings, and K a constant. *See table Atomic and Molecular Constants.*

Wien Displacement Law.—When the temperature of a radia ing black body increases, the wave length of every monochromat radiation decreases in such a way that the product of the te perature and wave length is constant.

$$\lambda T = \lambda_0 T_0$$

where λ and λ_0 are wave lengths and T and T_0 the correspondi absolute temperatures.

For the wave length of maximum energy,

$$\lambda_{max} T = \text{a constant.}$$

Wave Motion and Sound

Velocity of a Wave.—The velocity of propagation in tern of wave length λ and period T or frequency n is,

$$V = \frac{\lambda}{T} = n\lambda.$$

Velocity of Water Waves.—If the depth h is small compare with the wave length, the velocity,

$$V = \sqrt{gh}.$$

In deep water for a wave length λ,

$$V = \sqrt{\frac{g\lambda}{2\pi}}.$$

If the wave length is very small, less than about 1.6 cm, t velocity increases as the wave length decreases and is expresse by the following,

$$V = \sqrt{\frac{2\pi T}{\lambda d} + \frac{g\lambda}{2\pi}}$$

where T is the surface tension and d the density of the liqui V will be given in cm per sec. if h and λ are in cm, g in c per sec.^{2}, T in dynes per cm and d in g per cm^3.

Newton's Formula.—The velocity of a compressional wa in an elastic medium, in terms of elasticity E (bulk modulu and density d,

$$V = \sqrt{\frac{E}{d}}.$$

For the velocity of sound in air, where p is the pressure a d the density,

$$V = \sqrt{\frac{p}{d} 1.4}.$$

Velocity of Sound, Variation with Temperature.—The velocity in meters per sec. at any temperature T in °C. is given by,

$$V_T = V_0 \sqrt{1 + \frac{T}{273}}$$

or

$$V_T = 331.7 + .607 + T.$$

Doppler's Principle.—The apparent frequency of a sound as affected by motion of the hearer, the source and the medium is given by the following expression,

$$n = n_0 \frac{V + w - v_0}{V + w - v_s}$$

where n_0 is the original frequency of the source, V the velocity of sound, w that of the medium, v_0 that of the observer and v_s that of the source. Only the components of motion parallel to the line connecting the source and observer are to be considered. All velocities are taken in the direction from source to observer; if the motion is in the opposite direction the sign of the velocity substituted in the formula should be changed.

Velocity of a Transverse Wave in a stretched cord. If T is the tension of the cord and m the mass per unit length,

$$V = \sqrt{\frac{T}{m}}.$$

Frequency of Vibrating Strings.—For a string of circular section of length l, tension T, density d, and radius r, the frequency of the fundamental is,

$$n = \frac{1}{2rl} \sqrt{\frac{T}{\pi d}}.$$

The frequency in vibrations per second will be given if T is in dynes, r and l in cm and d in g per cm³.

Organ Pipes.—The frequency of vibration of a closed pipe of length l, where V is the velocity of sound in air, for the fundamental and first three overtones respectively is,

$$n_0 = \frac{V}{4l}, \quad n_1 = \frac{3V}{4l}, \quad n_2 = \frac{5V}{4l}, \quad n_3 = \frac{7V}{4l}.$$

For an open pipe,

$$n_0 = \frac{V}{2l}, \quad n_1 = \frac{2V}{2l}, \quad n_2 = \frac{3V}{2l}, \quad n_3 = \frac{4V}{2l}.$$

Intensity of Sound.—The energy in ergs per cm³ in a sound wave is given by

$$E = 2\pi^2 dn^2 a^2$$

where d is density in g per cm³, n is frequency in vib. per sec. and a is amplitude in cm. The energy reaching the ear in unit time will also be proportional to the velocity of propagation.

Static Electricity

Force between Two Charges.—If two charges q and q' ar at a distance r in a vacuum, the force between them is,

$$F = \frac{qq'}{r^2}.$$

The force will be given in dynes if q and q' are in electrostati units and r in cm.

Field Intensity, or force exerted on unit charge at a poin distant r from a charge q in a vacuum.

$$H = \frac{q}{r^2}.$$

If the dielectric in the above cases is not a vacuum the dielectric constant K must be introduced. The formula become.

$$F = \frac{qq'}{Kr^2}. \qquad H = \frac{q}{Kr^2}.$$

The value of K is frequently considered unity for air. If the dielectric constant of a vacuum is considered unity the value for air at 0° C. and 760 mm. pressure is 1.000576.

Potential at a point due to a charge q at a distance r,

$$V = \frac{q}{Kr}.$$

Energy of the Electric Field.—If H is the electric field intensity in electrostatic units and K the specific inductive capacity, the energy of the field in ergs per cm³ is,

$$E = \frac{KH^2}{8\pi}.$$

Capacity in terms of charge and potential. A conductor charged with a quantity q to a potential V has a capacity,

$$C = \frac{q}{V}.$$

Capacity of a spherical conductor of radius r,

$$C = Kr.$$

Capacity of two concentric spheres of radii r and r',

$$C = K\frac{rr'}{r - r'}.$$

Capacity of a parallel plate condenser, the area of whose plates is A and the distance between them d,

$$C = \frac{KA}{4\pi d}.$$

Capacities will be given in electrostatic units if the dimensions of condensers are substituted in cm. *See tables for values of K.*

Energy of a charged conductor in ergs where Q is the charge and V the potential in electrostatic units,

$$E = \tfrac{1}{2}QV.$$

Condensers in Parallel and Series. — If c_1, c_2, c_3, etc., represent the capacities of a series of conductors and C their combined capacity, —

when in parallel, $$C = c_1 + c_2 + c_3 + \ldots,$$

when in series, $$\frac{1}{C} = \frac{1}{c_1} + \frac{1}{c_2} + \frac{1}{c_3} \ldots.$$

Magnetism

Force between Two Magnetic Poles. — If two poles of strength m and m' are separated by a distance r in a medium whose permeability is μ (unity for a vacuum), the force between them is

$$F = \frac{mm'}{\mu r^2}.$$

Force will be given in dynes if r is in cm and m and m' are in C. G. S. units of pole strength.

The strength of a magnetic field at a point distant r from an isolated pole of strength m is,

$$H = \frac{m}{\mu r^2}.$$

The field will be given in gauss if m and r are in C. G. S. units. Values of the permeability μ will be found in tables elsewhere in the volume.

Magnetic Moment.—If the poles are separated by a distance which is great compared with the dimensions of the magnet, the magnetic moment of a magnet of length l whose poles have values of $+m$ and $-m$ is,

$$M = ml.$$

Couple acting on a magnet of magnetic moment ml in a field of strength H. If the magnet is perpendicular to the direction of the field,

$$C = Hml = HM.$$

If the angle between the magnet and the field is θ,

$$C = Hml \sin \theta.$$

The couple will be in dyne-cm for C. G. S. units of H, m and l.

Action of One Magnet on Another.—The turning moment experienced by a magnet of pole strength m' and length $2l'$ placed at a distance r from another magnet of length $2l$ and pole strength m, where the center of the first magnet is on the

axis (extended) of the second and the axis of the first is perpendicular to the axis of the second,

$$C = 8\frac{mm'll'}{r^3} = \frac{2MM'}{r^3}.$$

If the first magnet is deflected through an angle θ, the expression becomes,

$$C = \frac{2MM'}{r^3}\cos\ \theta.$$

Magnetic Field due to a magnet.

At a point on the magnetic axis prolonged, at a distance r cm from the center of the magnet of length $2l$ whose poles are $+m$ and $-m$ and magnetic moment M, the field strength in gauss is,

$$H = \frac{4mlr}{(r^2 - l^2)^2}.$$

If r is large compared with l,

$$H = \frac{2M}{r^3}.$$

At a point on a line bisecting the magnet at right angles with corresponding symbols,

$$H = \frac{2ml}{(r^2 + l^2)^{\frac{3}{2}}}.$$

For large values of r,

$$H = \frac{M}{r^3}.$$

Period of vibration of a magnet of magnetic moment M and moment of inertia I vibrating in a field of strength H,

$$T = 2\pi\sqrt{\frac{I}{MH}}.$$

Magnetic Induction.—If a substance of permeability μ is placed in a magnetic field H the magnetic induction in the substance,

$$B = \mu H.$$

If I is the magnetic moment for unit volume, or intensity of magnetization,

$$B = H + 4\pi I.$$

The susceptibility,

$$K = \frac{I}{H}, \qquad \mu = 1 + 4\pi K.$$

Hysteresis.—Steinmetz' equation for hysteresis gives the loss of energy in ergs per cycle per cm³,

$$W = \eta B^{1.6}$$

where B is the maximum induction in maxwells per cm^2 and η the coefficient of hysteresis. *See table Hysteresis.*

Tractive Force of a Magnet.—If a magnet with induction B has a pole face of area A the force is,

$$F = \frac{B^2 A}{8\pi}.$$

If B and A are in C. G. S. units, A will be in dynes.

Current Electricity

Ohm's Law. — Current in terms of electromotive force E and resistance R,

$$i = \frac{E}{R}.$$

The current is given in amperes when E is in volts and R in ohms.

Current in a Simple Circuit. The current in a circuit including an external resistance R and a cell of electromotive force E, and internal resistance r,

$$i = \frac{E}{R + r}.$$

If E is in volts and r and R in ohms the current will be in amperes.

For two cells in parallel,

$$i = \frac{E}{R + \frac{r}{2}}.$$

For two cells in series,

$$i = \frac{2E}{R + 2r}.$$

Resistance of a conductor at 0° C., of length l, cross-section s and specific resistance ρ,

$$R_0 = \rho \frac{l}{s}.$$

The resistivity may be expressed as ohm-cm when R is in ohms, l in cm and s in cm^2. *See table Resistivity.*

Resistance of a conductor at a temperature t whose resistance at 0° C. is R_0 and whose temperature resistance coefficient is α,

$$R_t = R_0(1 + \alpha t).$$

Resistance of Conductors in Series and Parallel. — The total resistance of any number of resistances joined in series is the sum of the separate resistances. The total resistance of conductors in parallel whose separate resistances are r_1, r_2, r_3, . . . r_n is given by the formula

$$\frac{1}{R} = \frac{1}{r_1} + \frac{1}{r_2} + \frac{1}{r_3} \ldots + \frac{1}{r_n}.$$

R is the total resistance.

For two terms this becomes,

$$R = \frac{r_1 r_2}{r_1 + r_2}.$$

Kirchoff's Laws.

I. The algebraic sum of the currents which meet at an point is zero.

II. In any closed circuit the algebraic sum of the product of the current and the resistance in each conductor in the circui is equal to the electromotive force in the circuit.

Wheatstone's Bridge. — If the resistances r_1, r_2, r_3, and form the arms of a Wheatstone's bridge in order as the circu (omitting cell and galvanometer connections) is traced, whe the bridge is balanced,

$$\frac{r_1}{r_2} = \frac{r_4}{r_3} \text{ or } \frac{r_1}{r_4} = \frac{r_2}{r_3}.$$

Electrical Energy. — The power in watts developed by a electric current flowing in a conductor, where E is the differenc of potential at its terminals in volts, r its resistance in ohm and i the current in amperes,

$$P = Ei = ri^2.$$

The work done in joules in a time t sec. is,

$$W = Eit \; : \; ri^2t.$$

Heat Effect. — The heat in calories developed in a circuit b an electric current of i amperes flowing through a resistance r ohms, with a difference of potential E volts for a time t second

$$H = \frac{ri^2t}{4.18} = \frac{Eit}{4.18}.$$

Electromagnetic Field. — The intensity of the magnetic fiel in gauss at the center of a circular conductor of radius r i which a current i in electromagnetic units is flowing,

$$H = \frac{2\pi i}{r}.$$

If the circular coil has n turns the magnetic intensity at th center is,

$$H = \frac{2\pi ni}{r}.$$

If i is given in amperes the above formulae become, —

$$H = \frac{2\pi i}{10r}, \quad H = \frac{2\pi ni}{10r}.$$

Magnetic Field in a Solenoid. — The magnetic field in long solenoid of n turns carrying a current i in electromagnet units,

$$H = 4\pi ni.$$

Tangent Galvanometer. — A tangent galvanometer with n turns, of radius r, in the earth's field H, has a deflection θ. The current flowing is,

$$i = \frac{Hr}{2\pi n} \tan \theta.$$

If $\frac{2\pi n}{r} = G$ (the galvanometer constant),

$$i = \frac{H}{G} \tan \theta.$$

Electrolysis. — If a current i flows for a time t and deposits a metal whose electrochemical equivalent is e, the mass deposited is

$$m = eit.$$

The value of e is usually given for mass in grams, i in amperes and t in seconds.

Lenz' Law. — When an electromotive force is induced in a conductor by any change in the relation between the conductor and the magnetic field, the direction of the electromotive force is such as to produce a current whose magnetic field will oppose the change.

Alternating current in circuits including resistance and inductance,

$$I = \frac{E}{\sqrt{R^2 + (2\pi nL)^2}}$$

where n is the frequency in cycles per second, L the inductance in henry. I will be given in virtual amperes if R is in ohms and E in virtual volts. The denominator is known as the impedance of the circuit.

For circuits also involving a capacity C in farads, the impedance becomes,

$$\sqrt{R^2 + \left(2\pi nL - \frac{1}{2\pi nC}\right)^2}.$$

Average Power in watts for alternating current in a circuit,

$$P = EI \cos \phi$$

where E and I are the effective values of the electromotive force and current in volts and amperes respectively and ϕ the phase angle between the current and the impressed electromotive force.

The ratio,

$$\frac{P}{EI} = \cos \phi$$

is called the power factor.

Light

Intensity of illumination in candle meters of a screen illumi nated by a source of illuminating power P candles at a distanc r meters, for normal incidence,

$$I = \frac{P}{r^2}.$$

If two sources of illuminating power P_1 and P_2 produc equal illumination on a screen when at distances r_1 and respectively,

$$\frac{P_1}{r_1^2} = \frac{P_2}{r_2^2} \quad \text{or} \quad \frac{P_1}{P_2} = \frac{r_1^2}{r_2^2}.$$

Spherical Mirrors. — If R is the radius of curvature, principal focus, and f_1 and f_2 any two conjugate focal distance

$$\frac{1}{f_1} + \frac{1}{f_2} = \frac{1}{F} = \frac{2}{R}.$$

If the linear dimensions of the object and image be O and respectively and u and v their distances from the mirror,

$$\frac{O}{I} = \frac{u}{v}.$$

Index of Refraction, Snell's Law. — If i is the angle of inc dence, r the angle of refraction, v the velocity of light in t first medium, v' the velocity in the second medium, the ind of refraction n,

$$n = \frac{\sin i}{\sin r} = \frac{v}{v'}.$$

For a prism of angle A where light passes at the angle minimum deviation D, the index of refraction,

$$n = \frac{\sin \frac{1}{2}(A + D)}{\sin \frac{1}{2}A}.$$

Total Reflection. — When light passes from any medium one in which the velocity is greater, refraction ceases and to reflection begins at a certain critical angle of incidence θ su that

$$\sin \theta = \frac{1}{n}$$

where n is the index of the first medium with respect to t second. If the second medium is air n has the ordinary va for the first medium. For any other second medium,

$$n = \frac{n_1}{n_2}$$

where n_1 and n_2 are the ordinary indices of refraction for first and second medium respectively.

Refraction at a Spherical Surface. — If u be the distance of a point source, v the distance of the point image or the intersection of the refracted ray with the axis, n_1 and n_2 the indices of refraction of the first and second medium, and r the radius of curvature of the separating surface,

$$\frac{n_2}{v} + \frac{n_1}{u} = \frac{n_2 - n_1}{r}.$$

If the first medium is air the equation becomes,

$$\frac{n}{v} + \frac{1}{u} = \frac{n - 1}{r}.$$

Lenses. — For a single thin lens whose surfaces have radii of curvature r_1 and r_2, whose principal focus is F, the index of the fraction n, and conjugate focal distances f_1 and f_2,

$$\frac{1}{F} = \frac{1}{f_1} + \frac{1}{f_2} = (n - 1)\left(\frac{1}{r_1} + \frac{1}{r_2}\right).$$

For a thick lens, of thickness t,

$$F = \frac{nr_1r_2}{(n - 1)\,[n(r_1 + r_2) - t(n - 1)]}.$$

Combinations of Lenses. — If f_1 and f_2 are the focal lengths of two thin lenses separated by a distance d the focal length of the system,

$$F = \frac{f_1 f_2}{f_1 + f_2 - d}.$$

Radius of Curvature from Spherometer Readings. — If l is the mean length of the sides of the triangle formed by the points of the three legs, d the spherometer reading, the radius of curvature of the surface is

$$R = \frac{l_2}{6d} + \frac{d}{2}.$$

Dispersive Power. — If n_1 and n_2 are the indices of refraction for wave lengths λ_1 and λ_2 and n the mean index or that for sodium light, the dispersive power for the specified wave lengths is,

$$\omega = \frac{n_2 - n_1}{n - 1}.$$

Lambert's Law. — When light is normally incident on a perfectly diffusing surface the intensity of the reflected light is proportional to the cosine of the angle made with the normal.

Reflection of Light by a Transparent Medium in Air. (Fresnel's Formulæ). — If i is the angle of incidence, r the angle of refraction, n_1 the index of refraction for air (nearly equal to unity),

n_2 index of refraction for a medium, then the ratio of the reflected light to the incident light is,

$$R = \frac{1}{2}\left[\frac{\sin^2 (i - r)}{\sin^2 (i + r)} + \frac{\tan^2 (i - r)}{\tan^2 (i + r)}\right].$$

If $i = 0$ (normal incidence), and $n_1 = 1$ (approximate for air),

$$R = \left(\frac{n_2 - 1}{n_2 + 1}\right)^2$$

Diffraction Grating. — If s is the distance between the rulings, d the angle of diffraction, then the wave length where the angle of incidence is 90° is (for the nth order spectrum),

$$\lambda = \frac{s \sin d}{n}.$$

If i is the angle of incidence, d the angle of diffraction, s the distance between the rulings, n the order of the spectrum, the wave length is,

$$\lambda = \frac{s}{n}(\sin i + \sin d).$$

Brewster's Law. — The tangent of the polarizing angle for a substance is equal to the index of refraction. The polarizing angle is that angle of incidence for which the reflected polarized ray is at right angles to the refracted ray.

Specific Rotation. — If there are n grams of active substance in v cubic centimeters of solution and the light passes through l centimeters, r being the observed rotation in degrees, the specific rotation (for 1 centimeter),

$$[\alpha] = \frac{rv}{nl}.$$

RADIO FORMULÆ

A collection of formulae useful in the computation of inductance, capacity, and other constants of oscillating circuits. From Radio Instruments and Measurements, Bureau of Standards.

Capacity

Units. — In the following formulæ all lengths are expressed in centimeters, areas in square centimeters; the dielectric constant K, is taken as unity for air. Capacities will be given in micromicrofarads = 10^{-12} farads. The electrostatic unit of capacity, sometimes called the centimeter = 1.1124 micromicrofarads.

Parallel plate condenser. — If s be the area of one plate; t, the thickness of the dielectric; K, the dielectric constant; and N, the number of plates, — the capacity

$$C = 0.0885\, K \frac{(N-1)s}{t}.$$

Variable condenser, semicircular plates. — Where N is the total number of parallel plates; r_1 the outer, and r_2 the inner radius of the plates; t, the thickness of the dielectric, and K the dielectric constant, — the maximum capacity is given by

$$C = 0.1390K \frac{(N-1)(r_1^2 - r_2^2)}{t}.$$

Isolated thin circular disk. — If d is the diameter of the disk

$$C = 0.354d.$$

Isolated sphere. — If d is the diameter of the sphere

$$C = 0.556d.$$

Two concentric spheres. — If r_1 is the radius of the outer sphere; r_2, that of the inner sphere; K, the dielectric constant of the material between the spheres,

$$C = 1.112K \frac{r_1 r_2}{r_1 - r_2}.$$

Two coaxial cylinders. — If r_1 is the radius of the outer cylinder; r_2, that of the inner; l, the length of the cylinders; K, the dielectric constant,

$$C = K \frac{0.2416\, l}{\log_{10} \frac{r_1}{r_2}}.$$

Single long wire parallel to the ground. — For a wire of length l; diameter, d; suspended at a height h above the ground, where the diameter is small compared with the length,

For $\frac{4h}{l} = \text{or} < l$ $\qquad C = \frac{0.2416\ l}{\log_{10}\frac{4h}{d} - k_1}$

For $\frac{l}{4h} = \text{or} < l$ $\qquad C = \frac{0.2416\ l}{\log_{10}\frac{2l}{d} - k_2}$

In which,

$$k_1 = \log_{10}\left[\frac{1+\sqrt{1+\left(\frac{4h}{l}\right)^2}}{2}\right] \qquad k_2 = \log_{10}\left[\frac{l}{4h}+\sqrt{1+\left(\frac{l}{4h}\right)^2}\right]$$

the values of which may be found in a table at the end of this section.

Vertical wire. — For a wire of length l, relatively high above the ground; of diameter d, the approximate capacity is as follows,

$$C = \frac{0.2416\,l}{\log_{10}\frac{2l}{d}}.$$

Two horizontal parallel wires at the same height. — If d is the diameter of each wire; l, the length of each; h, the height above the ground; D, the distance between wires, — where d and D are small compared to l,

$$C = \frac{0.1208\,l}{\log_{10}\frac{2D}{d} - \frac{D^2}{8h^2}}.$$

Two horizontal parallel wires, one above the other. — Use the preceding formula for parallel wires at the same height substituting the mean height for h.

Two parallel wires joined together, both at the same height. — Let l be the length of each wire; D, the distance between centers; h, the height above the ground; d_2 the diameter of cross section of the wire. If d^2 and D^2 are small compared with l^2 and $4h^2$ respectively

For $\frac{4h}{l} = \text{or} < l$ $\qquad C = \frac{0.4831\,l}{\log_{10}\frac{4h}{d} + \log_{10}\frac{2h}{D} - 2k_1}.$

For $\frac{l}{4h} = \text{or} < l$ $\qquad C = \frac{0.4831l}{\log_{10}\frac{2l}{d} + \log_{10}\frac{l}{D} - 2k_2}.$

k_1 and k_2 have the same significance as above and may be found from the tables at the end of the section.

Several wires in parallel. — If n parallel wires are joined together; D, the spacing between the wires; d, the diameter of the wire; h, the height above the ground; l, the length of the group, — the approximate capacity is,

$$C = \frac{1.112\,l}{\frac{p_{11} + (n-1)p_{12}}{n} - k}.$$

p_{11} and p_{12} may be computed from the following:

For $\frac{4h}{l}$ = or $< l$

$$p_{11} = 4.605\left[\log_{10}\frac{4h}{d} - k_1\right]$$

$$p_{12} = 4.605\left[\log_{10}\frac{2h}{D} - k_1\right]$$

For $\frac{l}{4h}$ = or $< l$

$$p_{11} = 4.605\left[\log_{10}\frac{2l}{d} - k_2\right]$$

$$p_{12} = 4.605\left[\log_{10}\frac{l}{D} - k_2\right]$$

Values of k, k_1, k_2 may be found in the following table.

TABLE 1

$\frac{4h}{l}$	k_1	$\frac{l}{4h}$	k_2	n	k	n	k
0	0	0	0	2	0	11	2.22
0.1	0.001	0.1	0.043	3	0.308	12	2.37
.2	.004	.2	.086	4	.621	13	2.51
.3	.009	.3	.128	5	.906	14	2.63
.4	.016	.4	.169	6	1.18	15	2.74
.5	.025	.5	.209	7	1.43	16	2.85
.6	.035	.6	.247	8	1.66	17	2.95
.7	.045	.7	.283	9	1.86	18	3.04
.8	.057	.8	.318	10	2.05	19	3.14
.9	.069	.9	.351			20	3.24
1.0	.082	1.0	.383				

INDUCTANCE

Units. — In the following formulæ all lengths are expressed in centimeters. The inductance calculated will be in microhenries = 10^{-6} henry.

Long straight round wire. — If l is the length; d, the diameter of cross section; μ the permeability of the material, — the inductance at zero or low frequency is,

$$L = 0.002\,l\left[2.303\log_{10}\frac{4l}{d} - 1 + \frac{\mu}{4}\right]$$

For all except iron wire $\mu = 1$ and the last term becomes 0.25. For wires whose length is less than about 1000 times the diameter the term $+\frac{d}{2l}$ should be added inside the brackets.

For any frequency:

$$L = 0.002\,l\left[2.303 \log_{10}\frac{4l}{d} - 1 + \mu\delta\right]$$

where δ is a quantity given in Table 2 below as a function of x. x is to be computed from the relation

$$x = 0.1405 d\sqrt{\frac{\mu f}{\rho}}$$

where d and μ are as above; f, the frequency and ρ the resistivity of the material of the wire expressed in microhm centimeters. (See Properties of Metallic Conductors.)

For copper at 20° C.

$$x = 0.1071\, d\sqrt{f}.$$

For wires other than iron, whose length is 100,000 times the diameter the inductance at infinite frequency is about 2 % less than at zero frequency.

TABLE 2

Values of δ for computing inductance at any frequency.

x	δ	x	δ
0	0.250	12	0.059
0.5	.250	14	.050
1.0	.249	16	.044
1.5	.247	18	.039
2.0	.240	20	.035
2.5	.228	25	.028
3.0	.211	30	.024
3.5	.191	40	.0175
4.0	.1715	50	.014
4.5	.154	60	.012
5.0	.139	70	.010
6.0	.116	80	.009
7.0	.100	90	.008
8.0	.088	100	.007
9.0	.078	∞	.000
10.0	.070		

Two parallel round wires, return circuit. — If l is the length of each wire; d, the diameter; D, the distance between centers of wires; μ the permeability, — the inductance for any frequency is

$$L = 0.004\,l\left[2.303\,\log_{10}\frac{2D}{d} - \frac{D}{l} + \mu\delta\right]$$

where δ is a quantity to be obtained from the table above as a function of x which is to be computed as explained for the previous formula.

For copper and at low frequency the term δ becomes 0.25.

Square of round wire. — If a is the length of the side of the square; d, the diameter of the wire; μ the permeability, the inductance for any frequency is,

$$L = 0.008\,a\left[2.303\,\log_{10}\frac{2a}{d} + \frac{d}{2a} - 0.774 + \mu\delta\right]$$

where δ is obtained as above. For low frequency and for wires other than iron δ becomes 0.25; for infinite frequency the value is zero.

Grounded horizontal wire, the Earth acting as return circuit. If l is the length of wire; h, the height above the ground; d, the diameter of the wire; μ the permeability and δ the frequency constant (see table 2), the inductance, — where d is small compared with l, — is given as follows:

For $\frac{2h}{l} = \text{or} < l$ $\qquad L = 0.002\,l\left[2.3026\,\log_{10}\frac{4h}{d} - P + \mu\delta\right]$

For $\frac{l}{2h} = \text{or} < l$ $\qquad L = 0.002\,l\left[2.3026\,\log_{10}\frac{4l}{d} - Q + \mu\delta\right]$

P and Q may be found in the following table.

TABLE 3

$\frac{2h}{l}$	P	$\frac{2h}{l}$	Q	$\frac{2h}{l}$	P	$\frac{2h}{l}$	Q
0	0	0	1.0000	0.6	0.5136	0.6	1.2918
0.1	0.0975	0.1	0.0499	.7	.5840	.7	1.3373
.2	.1900	.2	1.0997	.8	.6507	.8	1.3819
.3	.2778	.3	1.1489	.9	.7139	.9	1.4251
.4	.3608	.4	1.1975	1.0	.7740	1.0	1.4672
.5	.4393	.5	1.2452	...	.....	...	.....

The mutual inductance of the case above may be expressed,

For $\frac{2h}{l} = \text{or} < l$ $\qquad M = 0.002\, l\left[2.3026 \log_{10} \frac{2h}{D} - P + \frac{D}{l}\right]$

For $\frac{l}{2h} = \text{or} < l$ $\qquad M = 0.002\, l\left[2.3026 \log_{10} \frac{2l}{D} - Q + \frac{D}{l}\right]$

The values of P and Q are found in the table above.

Grounded wires in parallel. — Compute by the above formulae the inductance L_1 per unit length of a single wire and the mutual inductance M_1 per unit length of two adjacent wires, using the actual length in determining the ratios $\frac{2h}{l}$ $\frac{2l}{d}$ etc. Then the inductance of n parallel wires will be,

$$L = l\left[\frac{L_1 + (n-1)M_1}{n} - 0.001k\right]$$

where k is a function of n found in Table 1 under capacity formulae.

Circular ring of round wire. — If a is the mean radius of the ring; d, the diameter of the wire, the inductance at any frequency is

$$L = 0.01257a\left[2.303 \log_{10} \frac{16a}{d} - 2 + \mu\delta\right]$$

where δ is determined from the table above.

Circular coil of circular cross section. — For a coil of n fine wires wound with mean radius of the turns a, the cross section of whose winding is a circle of diameter d, the inductance at low frequency, for wire other than iron, neglecting insulation space is,

$$L = 0.01257an^2\left[2.303 \log_{10} \frac{16a}{d} - 1.75\right]$$

Torus with a single layer transverse winding, — a circular solenoid of circular cross section. If r is the distance from the center of the torus to the center of the transverse section; a the radius of the turns of the winding; n, the number of turns the inductance at low frequency is

$$L = 0.01257n^2\left[r - \sqrt{r^2 - a^2}\right]$$

Solenoid, single layer. If n is the number of turns; a the radius of the coil; b, the length, the approximate inductance at any frequency is,

$$L = \frac{0.03948a^2n^2}{b}K$$

where K is a function of $\frac{2a}{b}$ given in the table below.

TABLE 4

$\frac{2a}{b}$	K	$\frac{2a}{b}$	K	$\frac{2a}{b}$	K
0.00	1.0000	2.00	0.5255	7.00	0.2584
.05	.9791	2.10	.5137	7.20	.2537
.10	.9588	2.20	.5025	7.40	.2491
.15	.9391	2.30	.4918	7.60	.2448
.20	.9210	2.40	.4816	7.80	.2406
.25	.9016	2.50	.4719	8.00	.2366
.30	.8838	2.60	.4626	8.50	.2272
.35	.8665	2.70	.4537	9.00	.2185
.40	.8499	2.80	.4452	9.50	.2106
.45	.8337	2.90	.4370	10.00	.2033
.50	.8181	3.00	.4292	.....	.....
.55	.8031	3.10	.4217	11.0	.1903
.60	.7885	3.20	.4145	12.0	.1790
.65	.7745	3.30	.4075	13.0	.1692
.70	.7609	3.40	.4008	14.0	.1605
.75	.7478	3.50	.3944	15.0	.1527
.80	.7351	3.60	.3882	16.0	.1457
.85	.7228	3.70	.3822	17.0	.1394
.90	.7110	3.80	.3764	18.0	.1336
.95	.6995	3.90	.3708	19.0	.1284
1.00	.6884	4.00	.3654	20.0	.1236
1.05	.6777	4.10	.3602	22.0	.1151
1.10	.6673	4.20	.3551	24.0	.1078
1.15	.6573	4.30	.3502	26.0	.1015
1.20	.6475	4.40	.3455	28.0	.0959
1.25	.6381	4.50	.3409	30.0	.0910
1.30	.6290	4.60	.3364	35.0	.0808
1.35	.6201	4.70	.3321	40.0	.0728
1.40	.6115	4.80	.3279	45.0	.0664
1.45	.6031	4.90	.3238	50.0	.0611
1.50	.5950	5.00	.3198	60.0	.0528
1.55	.5871	5.20	.3122	70.0	.0467
1.60	.5795	5.40	.3050	80.0	.0419
1.65	.5721	5.60	.2981	90.0	.0381
1.70	.5649	5.80	.2916	100.0	.0350
1.75	.5579	6.00	.2854	.....	.....
1.80	.5511	6.20	.2795	.....	.....
1.85	.5444	6.40	.2739	.....	.....
1.90	.5379	6.60	.2685	.....	.....
1.95	.5316	6.80	.2633	.....	.....

Long multiple layer solenoid. — The inductance is given approximately by,

$$L = L_1 - \frac{0.01257n^2ac}{b}(0.693 + B_s)$$

where L_1 is the inductance calculated from the formula for single layer solenoid, n being the number of turns of the wind ing; a, the radius of the coil measured from the axis to th center of the cross section of the winding; b, the length of th coil; c, the radial depth of the winding; B_s a correction give in table below as a function of b/c.

TABLE 5

b/c	B_s	b/c	B_s
1	0.0000	16	0.3017
2	.1202	17	.3041
3	.1753	18	.3062
4	.2076	19	.3082
5	.2292	20	.3099
6	.2446	21	.3116
7	.2563	22	.3131
8	.2656	23	.3145
9	.2730	24	.3157
10	.2792	25	.3169
11	.2844	26	.3180
12	.2888	27	.3190
13	.2927	28	.3200
14	.2961	29	.3209
15	.2991	30	.3218

Square coil of rectangular cross section. — If a be the sid of the square measured to the center of the rectangular sectio which has sides b and c and if n be the number of turns,

$$L = 0.008an^2\left[2.303 \log_{10} \frac{a}{b+c} + 0.2235 \frac{b+c}{a} + 0.726\right]$$

If the cross section is a square $b = c$ and the expression becom

$$L = 0.008an^2\left[2.303 \log_{10} \frac{a}{b} + 0.447 \frac{b}{a} + 0.033\right]$$

Mutual Inductance

Two parallel wires. — If l be the length of each wire; the distance between, the inductance is

$$M = 0.002\,l\left[2.303 \log_{10} \frac{2l}{D} - 1 + \frac{D}{l}\right]$$

Coaxial solenoids, single layer coils, not concentric. If a the radius of the smaller coil; A, the radius of the larger: and n_2 the number of turns on the smaller and larger coil r spectively; $2l$ the length of the smaller coil; $2x$, the length

the larger; D, the distance between the centers of the coils measured along the common axis,

$$M = 0.009870\frac{a^2A^2n_1n_2}{2x \cdot 2l}\left[K_1k_1 + K_3k_3 + K_5k_5\right]$$

where

$$K_1 = \frac{2}{A^2}\left(\frac{x_2}{r_2} - \frac{x_1}{r_2}\right) \qquad k_1\ 2l$$

$$K_3 = \frac{1}{2}\left(\frac{x_1}{r_1^5} - \frac{x_2}{r_2^5}\right) \qquad k_3 = a^2l\left(3 - 4\frac{l^2}{a^2}\right)$$

$$K_5 = -\frac{A^2}{8}\left[\frac{x_1}{r_1}9\left(3 - 4\frac{x_1^2}{A^2}\right) - \frac{x_2}{r_2}9\left(3 - 4\frac{x_2^2}{A^2}\right)\right]$$

$$k_5 = a^4l\left(\frac{5}{2} - 10\frac{l^2}{a^2} + 4\frac{l^4}{a^4}\right)$$

where

$$x_1 = D - x \qquad r_1 = \sqrt{x_1^2 + A^2}$$

$$x_2 = D + x \qquad r_2 = \sqrt{x_2^2 + A^2}$$

The above is most accurate for short coils with relatively great distance between.

Coaxial, concentric solenoids, outer coil the longer. If a be the radius of the smaller coil; A, that of the larger; $2l$, the length of the inner coil; $2x$, the length of the outer; n_1 and n_2 the number of turns on the inner and outer coil respectively,

$$M = \frac{0.01974a^2n_1n_2}{g}\left[1 + \frac{A^2a^2}{8g^4}\left(3 - 4\frac{l^2}{a^2}\right)\right]$$

where $g = \sqrt{x^2 + A^2}$.

Coaxial, concentric solenoids, outer coil the shorter. Assuming the symbols as before except

$$g = \sqrt{l^2 + a^2}$$

$$M = 0.01974\frac{a^2n_1n_2}{g}\left[1 + \frac{A^2a^2}{8g^4}\left(3 - 4\frac{x^2}{a^2}\right)\right]$$

High Frequency Resistance

Cylindrical straight wires. — The ratio R/R_0 of the high frequency resistance to the resistance at low frequency may be found from the table below, by calculating first the value of x from the relation,

$$x = d\sqrt{\frac{2\mu f}{\rho}}$$

where d is the diameter of the wire in centimeters; μ, the magnetic permeability; f, the frequency; ρ, the resistivity in microhm-centimeters.

For copper wire $x = 10da$ where a has a value given by $x = 0.1071\sqrt{f}$. The value of a for various frequencies may be found in the second of the two tables below. The above method gives the high-frequency resistance of simple circuits of any shape where the length is great compared with the diameter of the wire and the different portions of the circuit are not close to each other.

TABLE 6

Ratio of High-Frequency Resistance to the Direct-Current Resistance

x	R/R_0	x	R/R_0	x	R/R_0
0	1.0000	5.2	2.114	14.0	5.209
0.5	1.0003	5.4	2.184	14.5	5.386
.6	1.0007	5.6	2.254	15.0	5.562
.7	1.0012	5.8	2.324	16.0	5.915
.8	1.0021	6.0	2.394	17.0	6.268
.9	1.0034	6.2	2.463	18.0	6.621
1.0	1.005	6.4	2.533	19.0	6.974
1.1	1.008	6.6	2.603	20.0	7.328
1.2	1.011	6.8	2.673	21.0	7.681
1.3	1.015	7.0	2.743	22.0	8.034
1.4	1.020	7.2	2.813	23.0	8.387
1.5	1.026	7.4	2.884	24.0	8.741
1.6	1.033	7.6	2.954	25.0	9.094
1.7	1.042	7.8	3.024	26.0	9.447
1.8	1.052	8.0	3.094	28.0	10.15
1.9	1.064	8.2	3.165	30.0	10.86
2.0	1.078	8.4	3.235	32.9	11.57
2.2	1.111	8.6	3.306	34.0	12.27
2.4	1.152	8.8	3.376	36.0	12.98
2.6	1.201	9.0	3.446	38.0	13.69
2.8	1.256	9.2	3.517	40.0	14.40
3.0	1.318	9.4	3.587	42.0	15.10
3.2	1.385	9.6	3.658	44.0	15.81
3.4	1.456	9.8	3.728	46.0	16.52
3.6	1.529	10.0	3.799	48.0	17.22
3.8	1.603	10.5	3.975	50.0	17.93
4.0	1.678	11.0	4.151	60.0	21.47
4.2	1.752	11.5	4.327	80.0	28.54
4.4	1.826	12.0	4.504	90.0	32.07
4.6	1.899	12.5	4.780	100.0	35.61
4.8	1.971	13.0	4.856	.....	.....
5.0	2.043	13.5	5.033	.....	.....

TABLE 7

Values of a ($= 0.1071\ f$) for various frequencies.

f	a	Wave-length meters	f	a	Wave-length meters
100	0.1071	.....	50,000	2.395	6,000
200	.1514	.....	60,000	2.624	5,000
300	.1855	.....	70,000	2.834	4,286
400	.2142	.....	80,000	3.029	3,750
500	.2395	.....	90,000	3.213	3,333
600	.2624	.....	100,000	3.387	3,000
700	.2834	.....	150,000	4.148	2,000
800	.3029	.....	200,000	4.790	1,500
900	.3213	.....	250,000	3.355	1,200
1,000	.3387	.....	300,000	5.866	1,000
2,000	.4790	.....	333,333	6.184	900
3,000	.5866	.....	375,000	6.564	800
4,000	.6774	.....	428,570	7.012	700
5,000	.7573	.....	500,000	7.573	600
6,000	.8296	.....	600,000	8.296	500
7,000	.8960	.....	700,000	8.960	429
8,000	.9579	.....	750,000	9.275	400
9,000	1.0160	.....	800,000	9.579	375
10,000	1.071	30,000	900,000	10.16	333
15,000	1.312	20,000	1,000,000	10.71	300
20,000	1.514	15,000	1,500,000	13.12	200
30,000	1.855	10,000	3,000,000	18.55	100
40,000	2.142	7,500	.....	.....	.....

Wave Length

The wave length in meters is given by the following expression when L, the inductance, is in microhenries and C, the capacity, is in microfarads. The resistance is assumed negligible.

$$\lambda = 1884\sqrt{LC}$$

VALUES OF "L C"

The following table gives values of the product of the inductance a capacity (L C) in microhenries and microfarads for wave lengths fr 1 to 20,000 meters, and the corresponding frequencies in kilocycles.

Wave length, meters	Frequency, kilocycles	L C Microhenries Microfarads	Wave length, meters	Frequency, kilocycles	L C Microhenr Microfara
1	300,000.	.00000028	570	526.3	.09141
10	30,000.	.00002816	580	517.2	.09467
20	15,000.	.0001129	590	508.5	.09803
30	10,000.	.0002530	600	500.	.1014
40	7,500.	.0004503	610	491.8	.1047
50	6,000.	.0007039	620	483.7	.1082
60	5,000.	.001014	630	476.2	.1117
70	4,286.	.001378	640	468.7	.1154
80	3,750.	.001801	650	461.5	.1188
90	3,333.	.002280	660	454.5	.1225
100	3,000.	.002816	670	447.8	.1263
110	2,727.	.003404	680	441.2	.1302
120	2,500.	.004052	690	434.8	.1341
130	2,308.	.004757	700	428.6	.1378
140	2,144.	.005518	710	422.5	.1419
150	2,000.	.006335	720	416.7	.1459
160	1,875.	.007204	730	411.	.1501
170	1,765.	.008134	740	405.4	.1540
180	1,667.	.009120	750	400.	.1583
190	1,579.	.01016	760	394.7	.1625
200	1,500.	.01129	770	389.6	.1668
210	1,428.5	.01239	780	384.6	.1714
220	1,364.	.01362	790	379.8	.1756
230	1,304.2	.01490	800	375.	.1801
240	1,250.	.01624	810	370.4	.1847
250	1,200.	.01755	820	365.9	.1893
260	1,153.8	.01901	830	361.4	.1941
270	1,111.	.02052	840	357.1	.1985
280	1,071.3	.02209	850	352.9	.2034
290	1,034.3	.02372	860	348.8	.2082
300	1,000.	.02530	870	344.8	.2132
310	967.7	.02704	880	340.9	.2179
320	937.5	.02884	890	337.1	.2229
330	909.1	.03069	900	333.3	.2280
340	882.4	.03250	910	329.7	.2332
350	859.1	.03446	920	326.1	.2381
360	833.3	.03648	930	322.6	.2434
370	810.8	.03856	940	319.1	.2487
380	789.5	.04070	950	315.9	.2541
390	769.2	.04277	960	312.5	.2595
400	750.	.04503	970	309.3	.2647
410	731.7	.04733	980	306.1	.2704
420	714.3	.04968	990	303.	.2759
430	697.7	.05198	1,000	300.	.2816
440	681.8	.05446	1,010	297.03	.2870
450	666.7	.05700	1,020	294.12	.2927
460	652.2	.05960	1,030	291.26	.2986
470	638.3	.06225	1,040	288.45	.3045
480	625.	.06485	1,050	285.71	.3105
490	612.2	.06757	1,060	283.	.3161
500	600.	.07039	1,070	280.37	.3222
510	588.2	.07327	1,080	277.78	.3283
520	576.9	.07606	1,090	275.23	.3345
530	566.	.07903	1,100	272.73	.3404
540	555.6	.08208	1,110	270.27	.3467
550	545.4	.08518	1,120	267.85	.3531
560	535.7	.08836	1,130	265.48	.3595

VALUES OF "L C" (Continued)

Wave length, meters	Frequency, kilocycles	L C Microhenries Microfarads	Wave length, meters	Frequency, kilocycles	L C Microhenries Microfarads
1,140	263.15	.3660	1,740	172.41	.8520
1,150	260.86	.3721	1,750	171.43	.8620
1,160	258.61	.3787	1,760	170.46	.8720
1,170	256.4	.3853	1,770	169.49	.8821
1,180	254.23	.3921	1,780	168.54	.8916
1,190	252.1	.3988	1,790	167.6	.9019
1,200	250.	.4052	1,800	166.67	.912
1,210	247.93	.4121	1,810	165.75	.9224
1,220	245.9	.4190	1,820	164.84	.9327
1,230	243.9	.4260	1,830	163.94	.9425
1,240	241.93	.4326	1,840	163.04	.9530
1,250	240.	.4397	1,850	162.22	.9634
1,260	238.09	.4469	1,860	161.29	.9741
1,270	236.22	.4541	1,870	160.43	.9844
1,280	234.37	.4610	1,880	159.58	.9948
1,290	232.56	.4683	1,890	158.73	1.0056
1,300	230.76	.4757	1,900	157.89	1.0164
1,310	229.01	.4831	1,910	157.06	1.0265
1,320	227.27	.4906	1,920	156.30	1.0375
1,330	225.56	.4978	1,930	155.44	1.0485
1,340	223.87	.5053	1,940	154.63	1.0597
1,350	222.22	.5130	1,950	153.84	1.0706
1,360	220.59	.5208	1,960	153.06	1.0811
1,370	218.97	.5281	1,970	152.28	1.0923
1,380	217.39	.5359	1,980	151.51	1.1035
1,390	215.83	.5438	1,990	150.75	1.1148
1,400	214.38	.5518	2,000	150.	1.1256
1,410	212.76	.5598	2,100	142.85	1.2412
1,420	211.26	.5674	2,200	136.36	1.3624
1,430	209.79	.5755	2,300	130.43	1.4893
1,440	208.34	.5837	2,400	125.00	1.6218
1,450	206.90	.5919	2,500	120.	1.7597
1,460	205.47	.5998	2,600	115.38	1.9026
1,470	204.08	.6081	2,700	111.11	2.0520
1,480	202.70	.6165	2,800	107.14	2.207
1,490	201.34	.6250	2,900	103.45	2.3663
1,500	200.	.6335	3,000	100.	2.533
1,510	198.68	.6416	3,100	96.77	2.705
1,520	197.36	.6502	3,200	93.75	2.883
1,530	196.07	.6590	3,300	90.91	3.085
1,540	194.80	.6670	3,400	88.24	3.255
1,550	193.56	.6760	3,500	85.91	3.448
1,560	192.31	.6849	3,600	83.33	3.648
1,570	191.06	.6938	3,700	81.08	3.854
1,580	189.86	.7028	3,800	78.95	4.065
1,590	188.67	.7118	3,900	76.92	4.281
1,600	187.5	.7204	4,000	75.00	4.500
1,610	186.34	.7295	4,100	73.17	4.732
1,620	185.19	.7387	4,200	71.43	4.966
1,630	184.05	.7480	4,300	69.77	5.206
1,640	182.93	.7573	4,400	68.18	5.451
1,650	181.82	.7662	4,500	66.67	5.700
1,660	180.73	.7756	4,600	65.22	5.956
1,670	179.64	.7852	4,700	63.83	6.219
1,680	178.57	.7946	4,800	62.500	6.486
1,690	177.51	.8037	4,900	61.22	6.759
1,700	176.46	.8134	5,000	60.00	7.038
1,710	175.44	.8231	5,100	58.82	7.32
1,720	174.42	.8329	5,200	57.69	7.61
1,730	173.41	.8422	5,300	56.60	7.91

VALUES OF "L C" (Continued)

Wave length, meters	Frequency, kilocycles	L C Microhenries Microfarads	Wave length, meters	Frequency, kilocycles	L C Microhenri Microfarad
5,400	55.56	8.21	10,600	28.30	31.6
5,500	54.55	8.51	10,800	27.78	32.8
5,600	53.57	8.83	11,000	27.275	34.0
5,700	52.63	9.15	11,200	26.785	35.3
5,800	51.72	9.47	11,400	26.315	36.6
5,900	50.85	9.81	11,600	25.86	37.9
6,000	50.	10.1	11,800	25.425	39.2
6,100	49.18	10.5	12,000	25.0	40.4
6,200	48.55	10.8	12,200	24.590	42.0
6,300	47.62	11.1	12,400	24.275	43.3
6,400	46.87	11.5	12,600	23.86	44.4
6,500	46.15	11.9	12,800	23.435	46.0
6,600	45.45	12.3	13,000	23.075	47.6
6,700	44.78	12.6	13,200	22.275	49.2
6,800	44.12	13.0	13,400	22.39	50.4
6,900	43.48	13.4	13,600	22.06	52.0
7,000	42.86	13.8	13,800	21.74	53.2
7,100	42.25	14.2	14,000	21.43	55.2
7,200	41.67	14.6	14,200	21.125	56.8
7,300	41.1	15.0	14,400	20.835	58.4
7,400	40.54	15.4	14,600	20.55	60.0
7,500	40.	15.8	14,800	20.27	61.6
7,600	39.47	16.3	15,000	20.00	63.2
7,700	38.96	16.7	15,200	19.735	65.2
7,800	38.46	17.1	15,400	19.48	66.1
7,900	37.98	17.6	15,600	19.23	68.4
8,000	37.50	18.0	15,800	18.990	70.4
8,100	37.04	18.5	16,000	18.75	72.0
8,200	36.59	18.9	16,200	18.52	74.0
8,300	36.14	19.4	16,400	18.295	75.6
8,400	35.71	19.9	16,600	18.07	77.6
8,500	35.29	20.3	16,800	17.855	79.6
8,600	34.88	20.8	17,000	17.645	81.2
8,700	34.48	21.3	17,200	17.440	83.2
8,800	34.09	21.8	17,400	17.24	85.2
8,900	33.71	22.3	17,600	17.045	87.2
9,000	33.33	22.8	17,800	16.855	89.2
9,100	32.97	23.3	18,000	16.665	91.2
9,200	32.61	23.8	18,200	16.485	93.2
9,300	32.26	24.3	18,400	16.305	95.2
9,400	31.91	24.9	18,600	16.13	97.2
9,500	31.59	25.4	18,800	15.955	99.6
9,600	31.25	25.9	19,000	15.795	101.6
9,700	30.93	26.5	19,200	15.625	103.6
9,800	30.61	27.0	19,400	15.465	106.0
9,900	30.31	27.6	19,600	15.305	108.0
10,000	30.00	28.1	19,800	15.155	110.4
10,200	29.41	29.3	20,000	15.00	112.4
10,400	28.845	30.4			

ACID PROOF WOOD STAIN

Solution No. 1	Solution No. 2
125 grams of copper sulphate	150 grams of good fresh anilin oil
125 grams of potassium chlorate	180 grams of concentrated hydrochloric acid
1000 grams of water	1000 grams of water

Wood must be free from paint, varnish, grease or chemicals. Apply two coats of solution No. 1 boiling hot with a paint brush, allowing each coat to dry thoroughly before the next coat is applied. Then apply two coats of solution No. 2 in the same way. When the wood is completely dried wash off excess chemicals with hot soapsuds. Finish with raw linseed oil. Polish comes from rubbing the oil down well with a cloth or sponge. Whenever the tables get dingy again go over them with a coat of linseed oil and rub smooth.

BLUE PRINT PAPER, Formula for Sensitizing

Solution A:	Water	50. c.c., 8.5 oz.
	Iron and ammonium citrate	10. grams, 1.7 oz.
Solution B:	Water	50. c.c., 8.5 oz.
	Potassium ferricyanide	8. grams, 1.4 oz.

Filter separately. The solutions, which may be preserved separately for some time, are best kept in the dark. For use, mix, in a dark room or by an artificial light of low intensity, equal quantities of the two solutions.

Any non-absorbent paper may be sensitized by brushing the solution over it rapidly with a soft, wide, flat brush, going over the surface twice, the second coat being applied in a direction at right angles to the first. An alternative method is to lower the paper, beginning at one edge, on to the surface of the solution in a tray and allow it to float for a few seconds. Care must be taken to exclude air bubbles. After sensitizing by either method, the paper should be hung by one edge in a dark room to dry.

CEMENTS

Glues of all kinds are useful for wood, leather, paper and glass, where the joints are not required to be waterproof.

For waterproof joints of nearly all substances, including metals, shellac may be used. Flakes of solid shellac may be used with heat or it may be used as a solution in alcohol.

Kotinsky cement, Chatterton's compound and other resinous cements are used for similar purposes and in the same way as solid shellac. Glass cells made up with compounds of this nature may be made impervious to alcohol by painting over the joints with a rubber cement made by melting up small pieces of rubber tubing and adding carbon disulphide to make a thin syrup.

For celluloid a cement made by dissolving celluloid shavings in acetone is recommended.

Brass fittings are usually cemented on glass tubing with sealing wax. The glass tube should be wound with thread or twine to secure a close fit. The glass and the brass fitting should be warmed slightly above the melting-point of wax. (Thick, or pressed glass should be warmed slowly.) Wax may be applied to both parts and the thread well saturated with the melted wax. Enough should be used to insure filling the space

completely. Join the parts while the wax is very soft and clamp in position until it is thoroughly cold.

For optical purposes, cementing glass, etc., Canada balsam is universally employed, and makes a permanent and nearly invisible joint.

CLEANING MERCURY

Mercury may be cleaned sufficiently for many laboratory purposes without distilling. Allow the mercury to fall in a fine spray into a quantity of dilute nitric acid, 25 parts of acid to 75 parts distilled water. After being passed through the acid one or more times it should be passed through distilled water and dried. Most of the water may be removed with a clean filter, and the mercury heated in a porcelain dish to about 110° C. To produce the spray the stem of a glass funnel may be drawn down so as to leave only a small opening for the escape of mercury or a glass tube with a capillary point attached to a funnel with a tightly fitting rubber tube.

A three- to four-foot length of one-inch glass tube closed at one end and supported in a vertical position may be used to contain the acid solution. If a small glass tube be fused into the lower closed end of the large tube, and bent so as to stand up for a distance a little greater than 1/13.6, the column of acid solution in the large tube, a U-tube is formed in which a short column of mercury supports the long column of acid solution.

The end of the small tube should be bent over at the top so as to facilitate the delivery of the mercury and a short piece of clean rubber tubing with a pinch-cock put on at the start. As soon as mercury enough has collected in the bottom of the tube the pinch-cock may be opened. The mercury will rise nearly or quite to the top of the small tube, and as the quantity increases will be delivered from the small tube as fast as it falls in the spray.

The reversed end of the small tube should be short to avoid forming a siphon, which would completely empty the apparatus.

An efficient procedure, especially if the mercury is greasy, consists in spraying the mercury by means of the above apparatus, first, through a dilute solution (10%) of potassium hydroxide, then through dilute nitric acid (10–15%) and finally through distilled water.

CLEANING OPTICAL SURFACES FOR SILVERING

(From Miller's Laboratory Physics, Ginn & Co., publishers by permission.)

Probably the most important part of the silvering process is the proper cleaning of the surface to be silvered.

The surface is thoroughly cleaned of grease or other organic matter by the usual methods, using alcohol or chromic acid. Then it should be carefully cleansed with strong nitric acid, the whole surface being firmly rubbed with clean cotton tied to a rod of wood or glass. Care should be taken not to injure the surface. Rinse with water, and then wash the surface thoroughly with a strong solution of caustic potash, rubbing with

cotton brush as before. Finally, rinse with distilled water, and keep the surface wet until it is placed in the silvering solution. If the distilled water wets the whole surface uniformly the cleaning may be sufficient; if it does not wet uniformly, the operations must be repeated. The fingers should not touch the edges of the glass during the latter cleaning operations, as a layer of organic matter is apt to spread over the surface and render the silvering uneven.

Dr. Brashear recommends that the surface, after the washings described above, be rubbed with prepared chalk on a cotton wad until it is thoroughly dry and clean. It may then be put into the silvering solution at one's convenience.

COLORED LIQUIDS

For rendering columns of water easily visible, add a few drops of one per cent alcoholic solution of fluorescein to a liter of water. The dilute solution of fluorescein is bright green by reason of its fluorescence, although colorless by transmitted light.

A small quantity of an aqueous (1%) solution of uranine (the sodium salt of fluorescein) may be used in place of the alcoholic solution mentioned above.

If solutions showing color by transmission are desired, dilute aqueous may be made with any of the following dyes:

Dye	Color
Erythrosine	Pink
Eosine	Pink (green fluorescence)
Rhodamine B	Pink (red fluorescence)
Ponceau 2R	Scarlet
Naphthol green	Green
Methylene green	Bluish green
Methylene blue	Blue
Methyl violet	Purple

CROSS HAIRS

The spider lines which serve as an index in reading telescopes may be quickly replaced in an emergency by single silk fibers (from ordinary sewing silk) attached by soft wax. Single fibers may easily be removed from an untwisted strand.

Spider web should be used in permanent work. The fibers of the egg nest of certain species are employed and may be obtained of most dealers in scientific apparatus. In mounting them the following suggestions may be useful: The cross hair diaphragm of the telescope should be removed and clamped in a horizontal position. A bow of brass wire, about No. 28, should be employed to stretch the fiber. A background of black velvet makes the fibers more easily visible. With soft wax or other convenient adhesive ready on both tips of the bow, a fiber of the required length is to be disentangled with tweezers and wrapped several times about the ends of the bow under tension sufficient to straighten the fiber. The fiber, now con-

veniently handled by the wire bow, should be cautiously lowered onto the diaphragm in the proper position, the wire left hanging.

A small drop of shellac varnish applied at each side will hold the fiber in position as soon as it is thoroughly dry, after which the ends of the fiber should be cut away.

FLUORESCENT SCREENS

For observations of the ultra-violet spectrum, moisten a small quantity of anthracene with water and brush a thin layer over a ground-glass surface. On drying most of the anthracene will adhere to the glass. The prepared surface should be placed so as to receive the radiation directly, glass being comparatively opaque to the shorter wave lengths.

GLASS-GRINDING FLUID

Turpentine	45 c.cm.
Ether (ethyl oxide)	22.5 c.cm.
Camphor gum	31 grams

To be used with powdered emery for grinding glass.

For smoothing edges a sheet of emery cloth moistened with the above solution may be used.

Plane surfaces should be ground on thick plate glass.

For grinding glass stoppers use coarse emery, turn in one direction, finish with fine emery.

LABELS FOR BOTTLES

Ordinary gummed labels written upon, preferably, with India ink, may be protected after being gummed to the bottle by a coat of lacquer or varnish. A more complete protection is obtained by painting the label, after it is in place, with melted paraffin.

MIRRORS FOR SPECTROMETER ADJUSTMENT

A small square of thick plate glass with edges ground smooth and silvered on one surface affords a means of accurate adjustment.

To avoid the necessity of frequently resilvering, which arises where the mirrors are in constant use, the following course is suggested:

From selected German plate mirror 2 to 3 mm. thick, cut two pieces of the same size, say 4×5 cm. Remove the protective layer of varnish or paint from both pieces by soaking in alcohol and rubbing with cotton, being careful not to injure the silver surface. From one piece remove every trace of varnish by repeated rinsing, dry and polish the silver surface thus exposed by stroking lightly with a chamois rouge pad. From the other piece remove the silver by nitric acid, wash thoroughly in distilled water and dry. Cement the clear piece on the silver face of the other with Canada balsam. This is accomplished by placing two or three drops of Canada balsam in xylol (obtained in collapsible tubes) on the center of the silver face, and

evenly lowering upon it the clear glass. The balsam should spread rapidly to the edges of the plates. Minute bubbles of air in the balsam film are harmless; if large bubbles are present the plates should be slipped apart, cleaned with alcohol and the process repeated.

The balsam will be sufficiently hard in a few days to allow the excess to be scraped from the edges and the plates bound together with lantern slide binding strip. Gentle heat may be used to harden the balsam more rapidly.

POLARITY TEST PAPER

Dissolve one gram of phenolphthalein in a small quantity of alcohol. Add the solution of phenolphthalein to 100 c.cm. of a 10 per cent solution of potassium chloride in distilled water. Filter paper should be soaked in the solution and dried. A strip of paper moistened with water and placed in contact with the two terminals will show a bright red stain at the negative terminal.

SILVERING GLASS

Brashear's Process

(From Miller's Laboratory Physics, Ginn & Co., publishers, by permission.)

Two solutions are required, one, the reducing solution, should be prepared at least a week before it is used, and it may be made in large quantity and kept in stock with advantage; the other solution is to be prepared when used.

Reducing Solution

Distilled water	700 c.cm.
Pure sugar (loaf, granulated or rock candy)	80 g.
When dissolved add	
Alcohol	175 c.cm.
Strong nitric acid (sp. gr. 1.42)	3 c.cm.
Add water to make	1000 c.cm.

For silvering, the mirror may rest face up on the bottom of a suitable dish; it may stand on edge, or be supported in any manner, face downward, dipping into the upper part of the solution. In the latter case, the mirror may be fastened with wax to a stick laid across the dish, or it may be supported on glass feet or on paraffined wood wedges. Dr. Brashear recommends that the mirror, if round, form the bottom of the silvering dish, which is completed by wrapping a strip of paraffined paper around the edge of the mirror, this being held in place by rubber bands or fastened with several wrappings of cord.

Having selected a dish and support for the mirror, measure with water the quantity of solution that will be required to make a layer a centimeter or two thick over the surface to be silvered. For each 150 c.cm. of final solution, 1 g. of silver nitrate and 0.5 g. of caustic potash (purified by alcohol) will be required. Dissolve the silver and potash separately, using quantities of water of the proportion of 100 c.cm. to 1 g

of the solid. Ordinary graduates or flasks are the most convenient form of vessel in which to mix the solutions. Into the silver nitrate solution pour a few drops of dilute aqua ammonia. The solution will turn to a dark brown color; add ammonia little by little till the precipitate is nearly but not quite redissolved. Now add the potash solution, when a precipitate will again be formed. This is to be nearly, but not entirely, redissolved by the addition of more ammonia, a few drops being sufficient this time. After the ammonia has been added shake or stir the solution well and wait a minute or two to be certain that it does not entirely clear. If by chance too much ammonia has been used, a little silver nitrate is to be dissolved and added, a few drops at a time, till a permanent precipitate is formed. This excess of silver must be present, the solution showing a decided brown tint. The solution may be filtered, though usually this is not necessary.

A quantity of reducing solution equal to about a twenty-fifth part of the solution just prepared is measured out. The mirror, having been properly cleaned and rinsed with distilled water, is placed in position. The reducing solution is poured into the silver and potash solution, and mixed by a quick shaking of the graduate or stirring with a glass rod; the whole is then poured into the dish. If the mirror is immersed face down, care is necessary to remove air bubbles; the mirror may well be immersed after the solution is in, being dipped in at one side first. If the mirror is at the bottom of the dish, after cleaning it is covered with a thin layer of water, and the prepared solutions are poured into the dish without further trouble. In the latter case the dish must be rocked during the time of deposition.

The solution soon turns to a black color, which in a few minutes will turn to a brown; and when it becomes a light gray and the precipitate is flocculent, which may be in ten or fifteen minutes, the operation is at an end. If the mirror is allowed to remain in the solution too long, the surface will have a bleached appearance, which polishing will hardly remove. Remove the mirror, rinse with water, and carefully wipe off the sediment with a tuft of absorbent cotton. It is then set on edge to dry; a rinsing with alcohol will facilitate the drying, or all water may be safely taken up by pressing clean blotting paper over the surface.

When dry, the surface may be polished, if necessary, with a small pad of chamois leather stuffed with cotton, on which is spread a little rouge. Small, circular strokes of the pad, with light pressure, will soon bring out the deep luster of the silver.

A uniform temperature of the bath and the glass, of about 20° is essential to success.

Since fulminating silver is liable to be produced by the action of ammonia on silver oxide, especially in a warm room, all solutions should be thrown away as soon as the silvering operation is completed. The used solutions may be poured into a large jar, in which is thrown some common salt; this causes the silver to be precipitated as the chloride, and about 90 per cent of the original silver may be recovered.

Rochelle Salts Process

(From Miller's Laboratory Physics, Ginn & Co., publishers, by permission.)

For depositing the uniform thin film of silver required on the half-silvered glass of the interferometer, the following method is more suitable than the one described above, as the silver is deposited more slowly. If a thick film is desired, two or more successive deposits may be made, each of which may require an hour's time.

Dissolve 5 g. of silver nitrate in 300 c.cm. of distilled water, and add dilute aqua ammonia until the precipitate formed is nearly, *but not entirely*, redissolved in the manner explained in the preceding method. Filter the solution and add water to make 500 c.cm.

Dissolve one g. of silver nitrate in a small quantity of water and pour into about half a liter of boiling water; dissolve 0.83 g. of Rochelle salts in a small quantity of water, and add to the boiling solution. Continue the boiling for half an hour, till the gray precipitate collects as a powder in the bottom of the flask. Filter hot, and add water to make 500 c.cm.

These solutions may be kept in the dark for a month or two.

For silvering, equal volumes of the two solutions are mixed, and the glass is supported in the mixture in whatever fashion is convenient. Various methods are mentioned in the preceding article. The thickest possible deposit may require an hour's time. A second deposit may be made upon the first if necessary to secure the desired thickness. The drying and polishing may be carried out as described above.

A half-silvered film will be produced in about a minute; only experience can determine when the proper thickness has been secured. The glass appears as though it were very lightly smoked. A film that reflects a little more than half the light incident at 45° is desirable for interferometer use. A simple method of testing is to look at two similar gas flames, one seen through the film and the other seen reflected by it. It is well to silver at once all four surfaces of the two plane-parallel plates of the interferometer and to select for use that film which is of the proper and most uniform thickness.

SOAP SOLUTION FOR SOAP FILM EXPERIMENTS

Pure castile or palm-oil soap	1 oz.
Distilled water	8 oz.
Pure glycerine	4 oz.

Cut the soap in thin shavings and dissolve in the water. When the solution is complete, add the glycerine and mix very thoroughly. On standing the liquid becomes clear at the bottom. The clear portion may conveniently be removed by a siphon and preserved indefinitely.

SODIUM LIGHT

Paper is to be soaked in a saturated solution of common salt, borax or other salt of sodium, and dried. When wrapped around a Bunsen burner, secured by a twist of wire and pushed up into the edge of the flame, a sodium flame of considerable intensity is obtained. As the ash of the paper breaks away it must be occasionally raised. Lithium chloride may be used in place of or with sodium salt to give the lithium line for spectrometric measurement. Sheet asbestos (thin) may replace the paper if convenient.

SOLDERS

Composition by weight.						Temperature of fusion.	Metals for which it is used.	Flux commonly used.
Lead.	Tin.	Copper.	Zinc.	Silver.	Gold.			
1	1	...	...	..	....	188° C.	Lead	Tallow
3	5	...	...	..	...	176	Zinc	Zinc chloride 25% HCl
2	5	...	...	..	...	170	Copper brass	Zinc chloride (neutral) or resin
							Iron	Zinc chloride or NH_4Cl
		2	1	..	...	.....	Fe, Cu,	Borax
		55	45	..	...	880	Fe, Cu, brass	Borax
		4.5	0.5	15.0	...	1005	Fe, Cu, Au,	Borax
		6.5	2.0	11.0	...	983	Fe, Cu, Au,	Borax
		4	....	6	10	.....	Gold	

STOPCOCK GREASE

Shepherd and Ledig (J. Ind. Eng. Chem. 19, 1059, 1927) prepare stopcock grease from the following ingredients by mixing with continuous stirring for 190 hours at 155° C., then placing the mixture in small 2 oz. containers, immediately chilling the contents on ice and allowing to age for 10 days before use. For high vacuum: 31 parts crepe rubber, 24 parts white vaseline 5 parts paraffin (m. p. 36° C.); for general lubricant: 6 parts crepe rubber, 7 parts vaseline, 1 part paraffin; for light lubricant 10 parts smoked sheet or pale crepe rubber, 18 parts vaseline and 1 part paraffin (m. p. 30° C.).

UNIVERSAL WAX

(1) A soft wax useful in the laboratory may be made by melting together paraffin, vaseline and paraffin oil in various proportions according to the pliability desired.

(2) Another authority recommends equal quantities of beeswax and turpentine (by weight). It is customary to color the wax by adding finely-powdered Venetian red.

(3) Melt together 1 part of Venice turpentine and 5 parts of beeswax. Color with vermilion.

PHOTOGRAPHIC FORMULÆ

Developers for Plates and Films

NOTE. — Pure water, preferably distilled, should be used in all solutions. Chemicals should be dissolved in the order given. The abbreviation "anhy." is used in connection with sodium sulphite and carbonate to indicate the anhydrous or dried salt. If crystals are used about twice the quantity is necessary.

AMIDOL (Diamidophenol)

1

Amidol	2–3 gr.	4.5–7 gm.
Sodium sulphite, anhy	12 gr.	29 gm.
Water	1 oz.	1000 cc.

Solution mixed as above will keep about one week.

2

Stock solution of sodium sulphite:

Sodium sulphite, anhy	2 oz.	100 gm.
Potassium metabisulphite	0.5 oz.	25 gm.
Water	20 oz.	1000 cc.

Boil after dissolving in warm water. Developer is made when needed by adding dry amidol to the stock solution of sulphite which keeps for a long period:

Stock solution of sodium sulphite	2 oz.	200 cc.
Water	10 oz.	1000 c.c.
Amidol	20–30 gr.	4.5–7 gm.

ELON. *See under Metol-Hydroquinone*

GLYCIN

Boiling water	4 oz.	1000 cc.
Sodium sulphite, anhy	1.25 oz.	312 gm.
When dissolved add:		
Glycin	1 oz.	250 gm.
Slowly add:		
Potassium carbonate (dry)	5 oz.	1250 gm.

Forms thick cream; for use, shake and dilute with water. Normal, 1 oz. stock solution to 15 oz. water; for less contrast use more water up to 30 oz.

Keeps indefinitely in stock solution, — slow acting, free from stain.

PHOTOGRAPHIC FORMULÆ (Continued)

HYDROQUINONE

1

Normal developer: —

Water	20 oz.	1000 cc.
Hydroquinone	100 gr.	11.5 gm
Sodium sulphite, anhy	0.75 oz.	38 gm
Sodium carbonate, anhy	1.5 oz.	75 gm

Becomes inert below 16° C. (60° F.). Is a rather slow developer.

2

Solution A: —

Water	20 oz.	1000 cc.
Hydroquinone	160 gr.	18 gm
Sodium sulphite, anhy	1 oz.	50 gm
Citric acid	60 gr.	7 gm
Potassium bromide	40 gr.	4.5 gm

Solution B: —

Sodium hydroxide (stick)	160 gr.	18 gm
Water	20 oz.	1000 c.c

For use take A, 1 oz.; B, 1 oz.; water, 2 oz.

A more rapid developer than No. 1 but tends to great density in high lights.

3

Developer for process work: —

Solution A: —

Water	40 oz.	1000 cc.
Hydroquinone	1 oz.	25 gm
Potassium metabisulphite	1 oz.	25 gm
Potassium bromide	1 oz.	25 gm

Solution B: —

Water	40 oz.	1000 cc.
Potassium hydroxide (caustic potash)	2 oz.	50 gm

To develop use equal parts A and B. Will develop in minutes at 65° F. (18° C.). Inert below 55° F. Use developer once only; if yellow stain occurs reduce bromide to half quantity.

METOL

Water, warm	20 oz.	1000 cc.
Metol	150 gr.	17 gm
Sodium sulphite, anhy	1.25 oz.	63 gm
Sodium carbonate, anhy	1.75 oz.	88 gm
Potassium bromide	16 gr.	1.8 gm

Always dissolve metol first.

For use dilute with equal part water for portraiture; for landscape use two parts of water to one of stock solution. Gives detail without density except by prolonged development.

PHOTOGRAPHIC FORMULÆ (Continued)

METOL-HYDROQUINONE

NOTE: — Elon may be used with hydroquinone in place of metol, in equal quantity.

Solution A:—
Dissolve in the order given:

Water	64 oz.	1820 cc.
Metol	120 gr.	7.8 gm.
Hydroquinone	120 gr.	7.8 gm.
Sodium sulphite, anhy.	2 oz.	57 gm.

Solution B:—

Water	16 oz.	455 cc.
Sodium carbonate, anhy.	2 oz.	57 gm.

For use take A, 4 oz.; B, 1 oz.; water, 4 oz.

FACTOR 15

MONOMET

Water	20 oz.	1000 cc.
Monomet	20 gr.	2.2 gm.
Sodium sulphite, anhy.	120 gr.	14 gm.
Sodium carbonate, anhy.	120 gr.	14 gm.
Potassium bromide, 10% sol.	20–40 drops	2–4 cc.

Use 1 part stock solution with 1 part water; gives soft negatives.

MONOMET-HYDROQUINONE

Water	20 oz.	1000 cc.
Monomet	16 gr.	2 gm.
Hydroquinone	32 gr.	4 gm.
Sodium sulphite, anhy.	120 gr.	14 gm.
Sodium carbonate, anhy.	120 gr.	14 gm.
Potassium bromide, 10% sol.	20 drops	2–4 cc.

For use take one part stock solution with one part water.

ORTOL

Solution A:—

Ortol	140 gr.	16 gm.
Potassium metabisulphite	70 gr.	8 gm.
Cold water	20 oz.	1000 cc.

Solution B:—

Sodium carbonate, anhy.	1.25 oz.	63 gm.
Sodium sulphite, anhy.	1.75 oz.	88 gm.
Potassium bromide	10–20 gr.	1.1–2.3 gm.
Water	20 oz.	1000 cc.

For rapid developer take A, 1 part; B, 1 part. For slower, softer development take A, 1 part; B, 1 part; water, 1 part.

PHOTOGRAPHIC FORMULÆ (Continued)

Paramidophenol

Water, boiling	20 oz.	1000 cc
Potassium metabisulphite	6 oz.	300 gn
Paramidophenol	2 oz.	100 gn

Add sodium or potassium hydroxide in small quantities to dissolve the precipitate first formed.

For use take 1 part stock solution with 20 parts water.

Pyro

1

Solution A:—		
Water	16 oz.	455 cc
Oxalic acid	12 gr.	0.8 gn
Pyrogallic acid	1 oz.	28 gn
Solution B:—		
Water	16 oz.	455 cc
Sodium sulphite, anhy	2 oz.	57 gn
Solution C:—		
Water	16 oz.	455 cc
Sodium carbonate, anhy	1 oz.	28 gn

For immediate use mix 1 part each of A, B and C with 1 parts water.

Factor 12

2

Hurter and Driffield standard developer for plate testing:—

Pyro	8 par
Sodium sulphite, crystal	40 "
Sodium carbonate, crystal	40 "
Water to make	1000 "

Factors

If the image first appears after immersion in the developer f a certain time, then this period of time multiplied by the "factor for the particular developer used will give the total time require for full, normal development. The factor for the degree development desired may well be determined by experimen the following are suggested.

Amidol, 2 gr. per oz.	18
Glycin	8–12
Hydroquinone	4½–5
Metol	30
Metol-hydroquinone	14
Ortol	10

PHOTOGRAPHIC FORMULÆ (Continued)

Pyro, without bromide: —

1 gr. per oz.	18
2 " " "	12
3 " " "	10
4 " " "	8
5 " " "	6

With 1 part bromide to 4 parts pyro: —

1 gr. pyro per oz.	9
2 " " " "	5
3 " " " "	4½
4 " " " "	4

FORMULÆ FOR TANK DEVELOPMENT

1

Water	48 oz.	1360 cc.
Sodium sulphite, anhy.	115 gr.	7.5 gm.
Sodium carbonate, anhy.	90 gr.	5.8 gm.
Pyro	45 gr.	2.9 gm.

Dissolve immediately before use. Use full strength.
Develop 15 minutes at 65° F. (18° C.).

2

Solution A: —		
Water	16 oz.	455 cc.
Oxalic acid	10 gr.	0.65 gm.
Pyro	1 oz.	28 gm.
Solution B: —		
Water	16 oz.	455 cc.
Sodium sulphite, anhy.	3 oz.	85 gm.
Solution C: —		
Water	16 oz.	455 cc.
Sodium carbonate, anhy.	1 oz.	28 gm.

For use take A, 1 part; B, 1 part; C, 1 part; water, 61 parts.
Develop 30 minutes at 65° F. (18° C.) for best results.

For temperature 60° F. develop 35 min.
" " 65° F. " 30 "
" " 70° F. " 25 "

3

Stock solution:		
Hot water (200° F.)	60 oz.	1700 cc.
Sodium carbonate, anhy.	2 oz.	57 gm.
Glycin	0.5 oz.	14 gm.
Sodium sulphite, anhy.	0.5 oz.	14 gm.

Dissolve in order. For use take stock solution, 6 parts; water, 58 parts.

For temperature 60° F. develop 30 minutes.
" " 65° F. " 25 "
" " 70° F. " 20 "

PHOTOGRAPHIC FORMULÆ (Continued)

DEVELOPER FOR LANTERN SLIDES

1

Water	20 oz.	568 cc.
Hydroquinone	60 gr.	3.9 gm
Sodium sulphite, anhy	120 gr.	7.8 gm
Potassium bromide	6 gr.	0.4 gm
Citric acid	6 gr.	0.4 gm
Sodium carbonate, anhy	1 oz.	28 gm

Use full strength.

2

Solution A:—		
Water	24 oz.	682 cc.
Sodium sulphite, anhy	3 oz.	85 gm
Hydroquinone	150 gr.	9.7 gm
Solution B:—		
Water	16 oz.	455 cc.
Potassium carbonate, anhy	2 oz.	57 gm
Potassium bromide	15 gr.	1 gm

For use take A, 3 parts; B, 2 parts.

FIXING BATHS FOR PLATES OR FILMS

A.	Water (1 gallon)	128 oz.	3600 cc.
	Hypo (sodium thiosulphate)	32 oz.	850 gm
B.	Water	32 oz.	852 cc.
	Sodium sulphite, anhy	3 oz.	85 gm
	Sulphuric acid, C. P.	0.5 oz.	14 cc.
	Chrome alum, powd.	2 oz.	56 gm

NOTE: — Be sure to mix Solution B exactly in given propo tions and rotation.

Always pour B into A while stirring well. If this is not don precipitation will take place.

During the cold season one half the quantity of Solution B sufficient for full quantity of Solution A.

This bath remains clear after frequent use, does not discol the negatives and hardens the film to such a degree that the neg tives can be washed in warm water and dried by artificial he if necessary. They should be left in the bath ten to twenty mi utes after the bromide of silver appears to have been dissolve to insure permanency, freedom from stain and perfect hardenin

If the bath becomes exhausted by continued use, replace by a new one.

It is not advisable to use this bath, which contains sulphur acid, in metal developing tanks.

PHOTOGRAPHIC FORMULÆ (Continued)

PLAIN FIXING BATH

Water	32 oz.	852 cc.
Hypo (sodium thiosulphate)	8 oz.	227 gm.

Do not use the bath when it is discolored; it must be made fresh each day.

INTENSIFICATION

Prepare the following solution, which will keep and work well until exhausted.

No. 1.	Water	16 oz.	455 cc.
	Mercuric chloride, $HgCl_2$	120 gr.	7.8 gm.
	Potassium bromide	120 gr.	7.8 gm.
No. 2.	Number 2 should be mixed fresh.		
	Water	8 oz.	227 cc.
	Sodium sulphite, anhy	1 oz.	28 gm.

After the negative is well fixed and washed, immerse in No. 1 until it has become thoroughly whitened, and after rinsing carefully place it in No. 2, leaving it there until entirely cleared. In case sufficient intensification has not been gained, wash for ten minutes, repeat the operation and finally wash well. If after intensification the negative is too dense it may be reduced by placing it for a few seconds in water 16 oz., hypo 1 oz.

If the negative has not been thoroughly fixed and washed before intensification, stains will ensue.

REDUCTION

A.	Water	16 oz.	455 cc.
	Hypo (sodium thiosulphate)	1 oz.	28 gm.
B.	Water	16 oz.	455 cc.
	Potassium ferricyanide	1 oz.	28 gm.

As this solution is affected by light, the bottle containing it should be of amber color or wrapped in opaque paper and kept in the dark when not in use.

Mix for immediate use: —

A . . . . . 8 parts
B . . . . . 1 part

Use in subdued daylight.

The negative can be placed in this solution directly after fixing. If a dry negative is to be reduced, it must be soaked in water for at least half an hour before applying the solution. To avoid streaks, always rinse the negative before holding it up for examination. As soon as sufficientlv reduced wash thoroughly.

IRON CLEARING SOLUTION

To remove yellow stain caused by pyro or hydroquinone developer, wash well to free from hypo and place in

Water	20 oz.	568 cc.
Ferrous sulphate, pure	3 oz.	85 gm.
Sulphuric acid, C. P.	1 oz.	28 gm.
Powdered alum	1 oz.	28 gm.

until stain is gone, then wash well.

DEVELOPERS FOR GASLIGHT PAPERS

Hydro-Metol

1

Water	16 oz.	455 cc.
Metol	18 gr.	1.2 gm.
Hydroquinone	18 gr.	1.2 gm.
Sodium sulphite, dry	204 gr.	13 gm.
Sodium carbonate, dry	408 gr.	26 gm.
Potassium bromide	10 gr.	0.6 gm.

If the whites fail to develop without fog, 10% potassium bromide solution may be added, a few drops at a time, until the desired results are obtained.

2

Water (soft or distilled)	40 oz.	1000 cc.
Metol	15 gr.	1 gm.
Sodium sulphite (dried powd.)	1 oz.	28 gm.
Hydroquinone	60 gr.	4 gm.
Sodium carbonate (dried powd.)	¾ oz.	21 gm.
Potassium bromide (10% solution)	40 drops	40 drops

Fixing Bath

Water	64 oz.
Hypo	16 oz.

Dissolve, then add the following acid hardener:

Water	5 oz.
Sodium sulphite (dried powd.)	½ oz.
Acetic acid, 25%	3 oz.
Alum (powd.)	½ oz.

This fixing bath is also excellent for dry plates and films, and will keep indefinitely before using; therefore it can be made up some time in advance. One pint of the bath should fix at least fifty 4 × 5 prints. The acid fixing bath can be used repeatedly. It keeps with but little care. It will by degrees become alkaline by the gradual addition of developer adhering to the prints. It should be discarded entirely when it becomes frothy, and a fresh bath prepared.

DIAPHRAGM NUMBERS

U. S.	1	equals F/4	U. S.	32	equals F/22
"	4	" F/8	"	64	" F/32
"	8	" F/11	"	128	" F/45
"	16	" F/16	"	256	" F/64

MEASURES AND UNITS

FUNDAMENTAL STANDARDS

The primary standard of *length* is defined as the distanc between two lines at 0° C on a platinum-iridium bar known a the International Prototype Meter deposited at the Internationa Bureau of Weights and Measures. The International Prototyp Meter is 1553164.13 times the wave length of the red cadmiu line in air, 760 mm. pressure, 15° C.

The primary standard of *mass* is defined as the mass of th International Prototype Kilogram of platinum-iridium kept a the International Bureau of Weights and Measures at Sèvre It is equal to the mass of 0.001000027 cubic meter of pure wate at 4° C and 760 mm. pressure.

The primary standard of *time* is the mean solar second, on eighty six thousand four hundredth (1/86400) part of a mea solar day.

The standard scale of *temperature* adopted by the Inte national Committee of Weights and Measures 1887 is based o the variations in pressure of hydrogen at constant volume The hydrogen is taken at an initial pressure, at the temperatu of melting ice, of one meter of mercury (0° C., sea level, latitud 45°). The scale is defined by taking the temperature of meltin ice as 0° and that of condensing steam under 760 mm. pressu as 100°. This is known as the Centigrade (C) scale.

The *absolute* or *thermodynamic temperature scale* proposed b Lord Kelvin is based on the average kinetic energy per molecul of a perfect gas. The temperature of melting ice is 273.13° an that of the boiling point of water 373.13°. This is frequentl referred to as the Kelvin (K) scale.

WEIGHTS AND MEASURES

Metric System

Lengths

Millimeters (mm)	Centimeters (cm)	Decimeters (dm)	Meters (m)	U. S. Equivalent	British Imperial Equivalent
1	0.1	0.01	0.001	0.0393700 inch	0.03937011 inch
10	1	.1	.01	0.393700 inch	0.3937011 inch
100	10	1	.1	3.93700 inches 0.3280833 foot	3.937011 inches 0.3280843 foot
1000	100	10	1	39.3700 inches 3.280833 feet	39.37011 inches 3.28084 feet

Meters (m)	Dekameters (dkm)	Hectometers (hm)	Kilometers (km)	U. S. Equivalent	British Imperial Equivalent
1	0.1	0.01	0.001	1.093611 yards 0.198838 rod	1.09361425 yards
10	1	.1	.01	10.93611 yards 1.98838 rods	10.9361425 yards
100	10	1	.1	19.8838 rods	109.361425 yards
1000	100	10	1	0.62137 mile	0.62137 mile

1 millionth micron ($\mu\mu$) = 10^{-12} meter = 10^{-10} centimeter = 0.01 Ångström units
1 Ångström unit or Ångström (Å U or A) = .0000000001 or 10^{-10} meter
1 milli-micron or micro millimeter ($m\mu$) = one one-thousandth micron = 10^{-7} centimeter = 10 Ångström units
1 micron (μ) .001 millimeter = 10^{-6} meter = 10^{-4} centimeter = 10,000 Ångström units = 0.00003937 inch
1 myriameter = 10,000 meters = 6.2137 miles

WEIGHTS AND MEASURES (Continued)

Metric System (Continued)

Area

Sq. Millimeters (mm^2)	Sq. Centimeters (cm^2)	Sq. Decimeters (dm^2)	Sq. Meters, Centares (m^2, ca.)	U. S. Equivalent	British Imperial Equivalents
1	0.01	0.0001	0.000001	0.00155 sq. in.	0.001550 sq. in.
100	1	.01	.0001	0.154999 sq. in.	0.155001 sq. in.
10,000	100	1	.01	15.4999 sq. in.	15.5001 sq. in.
1,000,000	10,000	100	1.	10.76387 sq. ft.	10.76390 sq. ft.

Sq. Meters, Centares (m^2, ca)	Sq. Dekameters Ares (dkm^2, a)	Sq. Hectometers Hectares (hm^2, ha)	Sq. Kilometers (km^2)	U. S. Equivalents	British Imperial Equivalents
1	0.01	0.0001	0.000001	0.039537 sq. rod	1.1960 sq. yds.
100	1	.01	.0001	0.02471 acre	119.60 sq. yds.
10,000	100	1	.01	2.471 acres	2.4711 acres
1,000,000	10,000	100	1	0.3861006 sq. mile	

Metric System (Continued)

Volume

Cu. Millimeters (mm^3)	Cu. Centimeters (cm^3, cc)	Cu. Decimeters (dm^3)	Cu. Meters (m^3)	U. S. and British Equivalents
1	0.001	0.000001	0.000000001	0.0000610 cu. inch
1000	1.	.001	.00001	0.0610 cu. inch
1,000,000	1000	1	.001	61.024 cu. inches
1,000,000,000	1,000,000	1,000	1	35.315 cu. feet,
				1.3080 cu. yards

1 stere = 1 cubic meter

Capacity

1 liter is the volume of pure water at 4° C. and 760 mm. pressure which weighs 1 kilogram. 1 liter = 1.000027 cubic decimeter = 1000.027 cubic centimeters.

Milliliter (ml)	Centiliters (cl)	Deciliter (dl)	Liter (l)	U. S. Equivalents	British Imperial Equivalents
1	0.1	0.01	0.001	16.231 minims 0.0610 cu. inch	0.0610 cu. inch
10	1	.1	.01	2.70518 fl. drams	0.070 gill
100	10	1	.1	3.38147 fl. ounces	0.176 pint
1000	100	10	1	270.518 fl. drams 33.8147 fl. ounces	1.75980 pints

WEIGHTS AND MEASURES (Continued)

Metric System (Continued)

Capacity (Continued)

Liters (l)	Dekaliters (dkl)	Hectoliters (hl)	Kiloliters (kl)	U. S. Equivalents	British Imperial Equivalents
1	0.1	0.01	0.001	1.05671 liq. quart 0.264178 gallon 1.1862 dry pints 0.9081 dry quart	.2200 gallon
10	1	.1	.01	18.162 dry pints 9.081 dry quarts 1.13513 pecks 2.8378 bushels	2.200 gallons
100	10	1	.1	.....	3.437 quarters
1000	100	10	1		

1230

Mass

Milligrams (mg)	Centigrams (cg)	Decigrams (dg)	Grams (g)	U. S. Equivalents	British Imperial Equivalents
1	0.1	0.01	0.001	0.015432356 grain	0.01543236 grain
10	1	.1	.01	0.15432356 grain	0.1543236 grain
100	10	1	.1	1.5432356 grains	1.543236 grains
				15.432356 grains	15.43236 grains
1000	100	10	1	0.5643833 dram av.	0.564383 dram av.
				0.03527396 ounce av.	0.0352739 ounce av.

Metric System (Continued)

Mass (Continued)

Grams (g)	Dekagrams (dkg)	Hectograms (hg)	Kilograms (kg)	U. S. Equivalents	British Imperial Equivalents
1	0.1	0.01	0.001	0.771618 scruple 0.2572059 dram apoth. 0.03215074 ounce apoth. 0.0022046 pound av.	0.77162 scruple 0.64301 pennyweight 0.03215 ounce troy
10	1	.1	.01	5.643833 drams av.	5.64383 drams av.
100	10	1	.1	3.527396 ounces av.	3.52739 ounces av.
1000	100	10	1	2.204622341 pounds av. 2.6792285 pounds Troy or apoth.	2.2046223 pounds av.

1 kilogram = 15432.35639 grains = 0.00110231 short ton = 0.00098421 long ton.
1 metric carat = 200 milligrams = 3.0864712 grains.
1 myriagram = 10000 g. = 10 kg. = 22.04622 pounds av.
1 quintal = 100 kg. = 220.46 pounds av.
1 millier or tonne = 1000 kg. = 220462. pounds av. = 2679.23 pounds troy = 0.98420640 long ton = 1.1023112 short tons.

Prefixes

The prefixes mega-, meaning one million, and micro-, one millionth, are used in connection with various simple and derived units of the metric system.

WEIGHTS AND MEASURES (Continued)

U. S. System

Miscellaneous Units and Equivalents

LENGTHS

The United States standard yard is defined as 3600/3937^{ths} meter.

Inches (in.)	Feet (ft.)	Yards (yd.)	Rods (rd.)	Miles (mi.)	Metric Equivalent
1	0.08333	0.027778	0.00505051	0.000015783	2.54001 centimeters
12	1	.33333	.0606061	.000189394	0.304801 meter
36	3	1	.0181818	.000568182	0.914402 meter
198	16.5	5.5	1	.003125	5.029210 meters
63,360	5280.	1760.	320.	1	1.60935 kilometers

1 mil = 0.001 inch = 25.4001 microns = .0254001 millimeter
1 hand = 4 inches = 10.1600 centimeters
1 span = 9 inches = 22.86005 centimeters
1 fathom (fath.) = 6 feet = 1.828804 meters
1 link (li.) = 0.66 foot = 7.92 inches = 20.11684 centimeters
1 rod (rd.) = 25 links = 5.029210 meters
1 surveyor's or Gunter's chain (ch.) = 4 rods = 100 links = 66 feet = 20.11684 meters
1 engineer's or Ramsden's chain = 100 links of one foot each = 100 feet = 30.4801 meters
1 knot or nautical mile = 1.1516 statute miles = 6080.27 feet = 1.85325 kilometers = 1′ of arc on the Earth's surface at the equator

U. S. System (Continued)

Lengths (Continued)

1 British yard = 3 feet = 36 inches = 0.914399 meter
1 British inch = 2.539998 centimeters
1 British mile = 1760 yards = 1.60934 kilometers
1 furlong (fur.) = 40 rods = 220 yards = 660 feet = 201.168 meters
1 pole (British) = 5.5 yards = 5.0292 meters = approximately 1 rod
1 British fathom = 6.08 feet
1 toise = 6 Paris feet = 1.94904 meters
1 Paris foot (pied) = 12 Paris inches = 0.324839 meter
1 Paris inch (ponce) = 12 Paris lines = 2.70700 centimeters
1 Paris line (ligne) = .225583 centimeter
1 light year = 5.9×10^{12} miles = 9.5×10^{12} kilometers
1 point (type sizes) = 1/72 or 0.01389 inch.
1 line = 1/12 or 0.08333 inch.
1 cubit = 18 inches

WEIGHTS AND MEASURES (Continued)

U. S. System (Continued)

AREA

Sq. Inches (sq. in.)	Sq. Feet (sq. ft.)	Sq. Yards (sq. yd.)	Sq. Rods (sq. rd.)	Acres (A.)	Sq. Miles (sq. mi.)	Metric Equivalent
1	0.0069444	.....	.....	.....	.....	6.452 sq. centimeters
144	1	0.111111	.....	.....	.....	0.09290 sq. meter
1296	9	1	0.03305785	.....	.....	0.8361 sq. meter
.....	272.25	30.25	1	0.00625	.....	25.29295 sq. meters or centares
.....	43560	4840	160	1	0.0015625	40.46873 ares
.....	27,878,400	3,097,600	102,400	640	1	2.589998 sq. kilometers

1 square mil = .000001 square inch = .000645 square millimeters
1 circular mil = area of a circle whose diameter is one mil = .000000785 square inches
1 square link = 62.7264 square inches = 404.6873 square centimeters
1 square rod (sq. rd.) = 625 square links = 25.29295 square meters
1 square chain (sq. ch.) = 16 square rods = 404.6873 square meters
1 acre (A) = 10 square chains = 4046.873 square meters

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1 British square yard = 9 square feet = 0.836126 square meter
1 British square foot = 144 square inches = 9.2903 square decimeters
1 British square inch = 6.4516 square centimeters
1 perch (British) = 30.25 square yards = 25.293 square meters
1 rood (British) = 40 perches = 10.117 ares or square dekameters
1 acre (British) = 4 roods

WEIGHTS AND MEASURES (Continued)

U. S. System (Continued)

VOLUME

Cubic Inches (cu. in.)	Cubic Feet (cu. ft.)	Cubic Yards (cu. yd.)	Metric Equivalent
1	0.00057870	.....	16.387 cubic centimeters
1728	1	0.037037	0.02832 cubic meter
46,656	27	1	0.765 cubic meter

1 board foot (bd. ft.) = 144 cubic inches = 2359.8 cubic centimeters
1 cord = 128 cubic feet = 3.625 cubic meters
1 British cubic foot = 1728 cubic inches = 0.028317 cubic meter
1 British cubic yard = 27 cubic feet = 0.76455 cubic meter
1 cubic foot = 6.229 British gallons
1 cubic yard = 168.17 British gallons

WEIGHTS AND MEASURES (Continued)

U. S. System (Continued)

CAPACITY — LIQUID MEASURE

Gills	Pints (pt.)	Quarts (qt.)	Gallons (gal.)	Cubic Inches	Metric Equivalent
1	0.25	0.125	0.03125	7.21875	118.292 milliliters
4	1	0.5	0.125	28.875	0.473167 liter
8	2	1	0.25	57.75	0.946333 liter
32	8	4	1	231.	3.785332 liters

1 gill = 4 fluid ounces = 1.18 deciliters
1 gallon (U. S.) of water at 15° weighs about 8.337 pounds av. or 3.782 kilograms = 0.83268 British gallon
1 hogshead = 63 gallons
1 firkin = 9 gallons = 34.06799 liters
1 tun = 252 gallons
1 British gill = 1.42 deciliters
1 British pint = 4 gills = 0.568 liter
1 British quart = 2 pints = 1.136 liters
1 British gallon = 4 quarts = 277.3 cubic inches = 0.160 cubic foot = 4.5459631 liters
1 British gallon of water at 15° C. weighs 10 pounds = 1.20094 U. S. gallons

U. S. System (Continued)

Apothecaries' Fluid Measure

Minims (min. or ♏)	Fluid Drams (fl. dr. or ℥)	Fluid Ounces (fl. oz. or ℥)	Pints (pt.)	Metric Equivalent
1	0.016667	0.0020833	.....	0.0616102 milliliter
60	1	0.125	.....	3.69661 milliliters
480	8	1	0.625	29.5729 milliliters
7680	128	16	1	0.473167 liter

1 fluid ounce = 1.80469 cubic inches
1 gallon = 128 fluid ounces = 8 pints
1 British Imperial gallon = 8 pints = 160 fluid ounces = 4.5459631 liters
1 British fluid ounce = 8 drachms = 28.4123 cubic centimeters
1 British fluid drachm = 60 minims = 3.5515 cubic centimeters
1 British minim = 0.05919 cubic centimeters

WEIGHTS AND MEASURES (Continued)

U. S. System (Continued)

Dry Measure

Pints (pt.)	Quarts (qt.)	Pecks (pk.)	Bushels (bu.)	Cubic Inches	Metric Equivalents
1	0.5	0.0625	0.015625	33.6003125	0.550599 liters
2	1	0.125	0.03125	67.200625	1.101198 liters
16	8	1	0.25	537.605	8.80958 liters
64	32	4	1	2150.42	35.2383 liters

1 British peck = 2 British gallons = 554.6 cubic inches = 9.092 liters
1 British bushel = 8 British gallons = 2218.192 cubic inches = 36.37 liters = 1.03151 U. S. bushels
1 British quarter = 8 bushels = 2.909 hectoliters
1 U. S. bushel = 0.96945 British bushel

Mass

Note: Three systems are in use, — avoirdupois, troy, and apothecaries'. The grain is the same in all.

U. S. System (Continued)

Avoirdupois — Commercial

The U. S. Standard pound avoirdupois is defined as 453.5924277 grams.

Grains (gr.)	Drams (dr. av.)	Ounces (oz. av.)	Pounds (lb. av.)	Tons (short) (tn.)	Metric Equivalents
1	0.03657	.....	.....	.....	0.06479818 gram
27.34375	1	0.0625	.....	.....	1.771845 grams
437.5	16	1	0.0625	.....	28.349527 grams
7000.	256	16	1	0.0005	453.5924 grams 0.4535924 kilogram
.....	.....	32000	2000	1	907.18486 kilograms

1 pound avoirdupois is the mass of 27.692 cubic inches of water weighted in air at 4° C., 760 mm. pressure
1 short hundredweight (cwt.) = 100 pounds = 45.359243 kilograms
1 short ton = 20 short hundredweight = 2,430.56 troy pounds = 907.18486 kilograms
1 stone (British) = 14 pounds = 6.350 kilograms
1 quarter (British) = 28 pounds = 12.70 kilograms
1 long hundredweight (British) = 4 quarters = 112 pounds = 50.802352 kilograms
1 long ton (British) = 20 long hundredweight = 1016.04704 kilograms
1 long ton = 1.12000 short tons = 2722.22 troy pounds = 1.01605 metric tons
1 short ton = 0.89287 long ton = 29,166.66 troy or apothecaries' ounces = 0.90718 metric ton
1 avoirdupois pound = 1.21528 troy or apothecaries' pounds = 14.5833 troy ounces
1 avoirdupois ounce = 0.9115 troy or apothecaries' ounce = 0.00044643 long ton = 0.00045359 metric ton

WEIGHTS AND MEASURES (Continued)

U. S. System (Continued)

TROY WEIGHT

Grains (gr.)	Pennyweights (dwt.)	Ounces (oz. t.)	Pounds (lb. t.)	Metric Equivalents
1	0.0416667	0.0020833	.....	64.798918 milligrams = 0.064798918 gram
24	1	0.05	0.0041667	1.555174 grams
480	20	1	0.08333	31.103481 grams
5760	240	12	1	373.24177 grams

1 troy pound = $\frac{5760}{7000}$ or 0.822857 avoirdupois pound = 13.1657 avoirdupois ounces

1 carat (1877) = 3.168 grains = 205.6 milligrams
1 troy ounce = 1.09712 avoirdupois ounces
1 troy pound = 0.00036735 long ton = 0.0041143 short ton = 0.00037324 metric ton

WEIGHTS AND MEASURES (Continued)

U. S. System (Continued)

Apothecaries' Weight

Grains (gr.)	Scruples (℈ or s. ap.)	Drams (ʒ or dr. ap.)	Ounces (℥ or oz. ap.)	Pounds (lb. ap.)	Metric Equivalents
1	0.05000	0.016667	0.0020833	.....	64.798918 milligrams
20	1	0.3333	0.041667	0.003472	1.2959784 grams
60	3	1	0.12500	0.010416	3.8879351 grams
480	24	8	1	0.08333	31.103481 grams
5760	288	96	12	1	373.24177 grams

Time

Seconds (sec.)	Minutes (min.)	Hours (hrs.)	Days	Years (yrs.)
1	0.016667	0.00027778		
60	1	0.016667	0.000490196	
3600	60	1	0.041667	
86400	2040	24	1	
.....	.....	.....	365.242218	1 (common)
.....	.....	.....	365.256	1 (sidereal)

1 lunar month (mo.) = 29 days 12 hr. 44 min.

1 sidereal second = 0.99727 mean solar second

WEIGHTS AND MEASURES (Continued)

U. S. System (Continued)

Angle

Seconds (″)	Minutes (′)	Degrees (°)	Circumference	
1	0.016667	0.00027778	.....	2π radians = 360° = circumference
60	1	0.016667	.....	π radians = 180°
3600	60	1	0.0027778	$\frac{\pi}{2}$ radians = 90°
1,296,000	12,600	360	1	$\frac{\pi}{4}$ radians = 45°

1 degree = 0.017453 radian

1 radian = 57° 17′ 44.8″ = 57.2958° = 3437.75′ = 206265″ = $\frac{1}{2\pi}$ of a circumference

1 grade = $\frac{1}{400}$ circumference = 100 centesimal minutes = 0.0157079 radian

1 centesimal minute = 100″ centesimal seconds

Solid Angle

1 steradian = $\frac{1}{4\pi}$ of the solid angle around a point.

CONVERSION OR REDUCTION FACTORS

Various Derived Units

Density

1 pound per cubic foot = 0.01602 gram per cubic centimeter
1 gram per cubic centimeter = 62.4 pounds per cubic foot

Velocity

1 foot per second = 0.6818 mile per hour = 1.0973 kilometers per hour
1 mile per hour = 44.70 centimeters per second = 1.4667 feet per second = 1.6093 kilometers per hour
1 kilometer per hour = 0.9113 foot per second = 0.6214 mile per hour
1 meter per second = 2.2369 miles per hour
1 centimeter per second = 0.02237 mile per hour

Acceleration

1 foot per second per second = 30.4796 centimeters per second per second

Force

1 pound weight = 32.2 poundals ($g = 32.2$)
1 poundal = 13,825 dynes
1 dyne = 7.2330×10^{-5} poundals = 2.247×10^{-6} pounds weight ($g = 981$) = 0.001019 gram weight = 0.01573 grain weight
1 gram weight = 981 dynes
1 grain weight = 63.57 dynes

Note: The relation between gravitational and absolute units of force is dependent on the value of g, the acceleration due to gravity. Thus the gravitational unit is g times the absolute unit, — g being substituted in cm. per sec.^{2} for the metric and in ft. per sec.^{2} for the English units.

Pressure

(See also table *Conversion of Pressure Units*)

1 ton (2000 lb.) per sq. inch = 1.3789×10^8 dynes per square centimeter = 1.4062 kilograms per square millimeters ($g = 980.6$)
1 ton (2240 lb.) per sq. inch = 1.545×10^8 dynes per square centimeter = 152.4 atmospheres = 1.575 kilograms per square millimeter ($g = 981$)
1 inch of mercury = 0.0333 atmosphere = 13.6 inches of water = 0.490 pound per sq. inch
1 inch of water = 0.03613 pound per sq. inch

1 pound per square foot = 0.016 foot of water = 4.882 kilogram per square meter
1 pound per square inch = 2.312 feet of water = 2.040 inches of mercury = 0.0703 kilogram per sq. centimeter
1 atmosphere = 34.0 feet of water = 760 millimeters of mercury = 14.7 pounds per sq. inch
1 kilogram per square centimeter = 14.22 pounds per square inch 76 cm. of mercury at 0° C. (g = 980) = 1,012,63 dynes per cm.^{2} or 14.697 pounds per square inch

Work or Energy

(See also table Factors for Conversion of Energy Units

1 foot poundal = 421,403 ergs
1 joule = 10^7 ergs = 6
1 erg = 2.3730×10 foot-poundals
1 foot-pound = 1356.3×10^4 ergs = 0.138255 kilogram meter (g = 981)
1 megalerg = 10^6 ergs
1 lumen = 0.001496 watt
1 watt of max. visibility radiation = 668 lumens
1 calorie (20°) = 0.003965 B.T.U. = 1.162×10^{-6} = kilowat hours = 4.183 joules = 4.183×10^7 ergs
1 large calorie or kilogram calorie = 1000 small calories = 3.96 B.T.U.
1 British thermal unit (B.T.U.) = 0.0002931 kilowatt-hour 0.293 watt hours = 252.2 calories (20°) = 0.252 larg calory
1 kilowatt hour = 3,600,000 joules = 2,655,000 foot pounds 367,100 kilogram-meters = 860,300 calories (20°) = 341 B.T.U.

Power

1 horse power = 33,000 foot pounds per minute = 550 foo pounds per second = 746 watts (g = 981) = 745.2 wat (g. = 980) = 0.7452 kilowatts (g = 980) = 1.101387 for de cheval
1 watt = 1 joule per second = 10^7 ergs per second = 44.2385 foo pounds per minute (g = 981) = .00134 horse power
1 force de cheval = 75 kilogram meters per second = 735.7 watts = 0.98632 horse power
1 kilowatt = 1000 watts = 738 foot pounds per second = 1.3 horse power = 0.949 B.T.U. per second = 0.239 larg calory per second
1 British thermal unit (B.T.U.) per minute = 0.0233 horse pow
1 British thermal unit per second = 1052.6 watts

Thermal Capacity

1 large calorie per cubic meter = 0.1124 B.T.U. per cubic fo
1 large calorie per kilogram per degree centigrade = 1 B.T. per pound, per degree Fahrenheit
1 small calorie per gram per degree centigrade = 1 B.T.U. pound per degree Fahrenheit

1 B.T.U. per pound per degree Fahrenheit = 1 calory per gram per degree centigrade
1 B.T.U. per cubic foot = 8.90 large calories per cubic meter

Photometric Units

1 hefner unit = 0.9 international candle
1 lumen is emitted by .07958 spherical candle power
1 lumen emitted per ft.^{2} = 1.076 millilamberts (perfect diffusion)
1 spherical candle power emits 12.57 lumens
1 lux = 1 lumen incident per m.^{2} = .0001 phot = .1 milliphot
1 phot = 1 lumen incident per cm.^{2} 10,000 lux = 1000 milliphots
1 milliphot = .001 phot = .929 foot-candle
1 foot-candle = 1 lumen incident per ft.^{2} = 1.076 milliphots = 10.76 lux
1 lambert = 1 lumen emitted per cm.^{2} of a perfectly diffusing surface
1 millilambert = .929 lumen emitted per ft.^{2} (perfect diffusion)
1 lambert = .3183 candle per cm.^{2} = 2.054 candles per in.^{2}
1 candle per cm.^{2} = 3.1416 lamberts
1 candle per in.^{2} = .4968 lambert = 486.8 millilamberts

RELATIONS OF ELECTRICAL UNITS

1 ohm	$= 10^9$	electromagnetic	$= 1/9 \times 10^{-11}$ electrostatic
1 volt	$= 10^8$	electromagnetic	$= 1/3 \times 10^{-2}$ electrostatic
1 ampere	$= 10^{-1}$	electromagnetic	$= 3 \times 10^9$ electrostatic
1 coulomb	$= 10^{-1}$	electromagnetic	$= 3 \times 10^9$ electrostatic
1 farad	$= 10^{-9}$	electromagnetic	$= 9 \times 10^{11}$ electrostatic
1 farad	= 1,000,000 microfarads		
1 henry	$= 10^9$	electromagnetic	$= 1/9 \times 10^{-11}$ electrostatic

VALUE OF THE GAS CONSTANT R FOR VARIOUS UNITS

Units of pressure.	Units of Volume.	R per gram molecule.
Atmospheres	Volume at 0° C.	0.003662
Atmospheres	c. cm.	82.07
Atmospheres	liters	0.08207
Atmospheres	cubic meters	
Dynes per sq.cm. (barye)	c.cm.	8.3156×10^7
Kilograms per sq.m. (g. = 980.6)	c.cm.	8.48×10^5
		R per lb. molecule.
Pounds per sq.in.	cu.in.	18510.
Pounds per sq.in.	cu.ft.	10.71
Atmospheres	cu.in.	1260.
Atmospheres	cu.ft.	0.729

FACTORS FOR CONVERSION OF ENERGY UNITS

(From Perkins' Introduction to General Thermodynamics, John Wiley & Sons, publishers, by permission.)

	Gram-Calories (4° C.).	B.T.U.*	Joules.	Foot-pounds.	Kilogm.-meters.	Liter-atmos.	Cu.ft.-atmos.	Foot-Poundals	Horse-power Hours.
Gram-calorie...	1.	3.968×10^{-3}	4.185	3.087	.4267	4.130×10^{-2}	1.459×10^{-3}	99.31	1.5591×10^{-6}
B.T.U.....	252.	1	1055.	777.9	107.5	10.41	.3676	25030.	3.929×10^{-4}
Joule.....	.2389	9.482×10^{-4}	1.	.73756	.1019	9.689×10^{-3}	3.485×10^{-4}	23.73	3.725×10^{-7}
Foot-pound....	.3240	1.286×10^{-3}	1.356	1.	.113826	1.3381×10^{-2}	4.7253×10^{-4}	32.174	5.0505×10^{-7}
Kilogr.-meter ..	2.343	9.298×10^{-3}	9.806	7.2327	1.	9.678×10^{-2}	3.4177×10^{-3}	232.7	3.6529×10^{-6}
Liter-atmos....	24.21	9.607×10^{-2}	101.32	74.733	10.333	1.	3.5319×10^{-2}	2403.8	3.7734×10^{-5}

* At temp. of maximum density.

CONVERSION OF PRESSURE UNITS

(From Perkins' Introduction to General Thermodynamics, John Wiley & Sons, publishers, by permission.)

	Dynes per sq.cm.	Grams per sq.cm.	Kilo. per sq. meter.	Mm. of Mercury.	Atmospheres.	Lbs. per sq.in.	Lbs. per sq.ft.
Dynes per sq centimeter..	1.	1.0198×10^{-3}	1.0198×10^{-2}	7.5010×10^{-4}	9.8697×10^{-7}	1.4504×10^{-5}	2.0887×10^{-3}
Gram per sq. centimeter...	980.6	1	10	7.3551×10^{-1}	9.6777×10^{-4}	1.4223×10^{-2}	2.0481
Kilogram per sq. meter....	98.06	10^{-1}	1	7.3551×10^{-2}	9.6777×10^{-5}	1.4223×10^{-3}	2.0481×10^{-1}
Millimeter of mercury.....	1332.	1.3595	13.595	1	1.3158×10^{3}	1.9337×10^{-2}	2.7845
Atmosphere.....	1013200.	1033.3	10333	760	1	14.696	2116.32
Pound per square inch....	68944	70.308	703.12	51.715	6.8046×10^{-2}	1	144
Pound per square foot....	478.78	4.883×10^{-1}	4.883	3.5912×10^{-1}	4.7252×10^{-4}	6.9445×10^{-3}	1

In the two tables above the numbers show the value of the energy or pressure unit named at the left in the units named at the top. For example, 1 gram-calorie is equivalent to 3.968×10^{-3} B.T.U.

COMPARISON OF METRIC AND CUSTOMARY UNITS FROM 1 TO 10

Length

INCHES		MILLIMETERS	INCHES		CENTIMETERS	FEET		METERS	U. S. YARDS		METERS	U. S. MILES		KILOMETERS
0.03937	=	1	0.3937	=	1	1	=	0.304801	1	=	0.914402	0.62137	=	1
0.07874	=	2	0.7874	=	2	2	=	0.609601	1.093611	=	1	1	=	1.60935
0.11811	=	3	1	=	2.54001	3	=	0.914402	2	=	1.828804	1.24274	=	2
0.15748	=	4	1.1811	=	3	3.28083	=	1	2.187222	=	2	1.86411	=	3
0.19685	=	5	1.5748	=	4	4	=	1.219202	3	=	2.743205	2	=	3.21869
0.23622	=	6	1.9685	=	5	5	=	1.524003	3.280833	=	3	2.48548	=	4
0.27559	=	7	2	=	5.08001	6	=	1.828804	4	=	3.657607	3	=	4.82804
0.31496	=	8	2.3622	=	6	6.56167	=	2	4.374444	=	4	3.10685	=	5
0.35433	=	9	2.7559	=	7	7	=	2.133604	5	=	4.572009	3.72822	=	6
1	=	25.4001	3	=	7.62002	8	=	2.438405	5.468056	=	5	4	=	6.43739
2	=	50.8001	3.1496	=	8	9	=	2.743205	6	=	5.486411	4.34959	=	7
3	=	76.2002	3.5433	=	9	9.84250	=	3	6.561667	=	6	4.97096	=	8
4	=	101.6002	4	=	10.16002	13.12333	=	4	7	=	6.400813	5	=	8.04674
5	=	127.0003	5	=	12.70003	16.40417	=	5	7.655278	=	7	5.59233	=	9
6	=	152.4003	6	=	15.24003	19.68500	=	6	8	=	7.315215	6	=	9.65608
7	=	177.8004	7	=	17.78004	22.96583	=	7	8.748889	=	8	7	=	11.26543
8	=	203.2004	8	=	20.32004	26.24667	=	8	9	=	8.229616	8	=	12.87478
9	=	228.6005	9	=	22.86005	29.52750	=	9	9.842500	=	9	9	=	14.48412

COMPARISON OF METRIC AND CUSTOMARY UNITS FROM 1 TO 10—Continued

Area

SQUARE INCHES		SQUARE MILLIMETERS	SQUARE INCHES		SQUARE CENTIMETERS	SQUARE FEET		SQUARE METERS	SQUARE YARDS		SQUARE METERS	SQUARE MILES		SQUARE KILOMETERS
0.00155	=	1	0.1550	=	1	1	=	0.09290	1	=	0.8361	0.3861	=	1
0.00310	=	2	0.3100	=	2	2	=	0.18581	1.1960	=	1	0.7722	=	2
0.00465	=	3	0.4650	=	3	3	=	0.27871	2	=	1.6723	1	=	2.5900
0.00620	=	4	0.6200	=	4	4	=	0.37161	2.3920	=	2	1.1583	=	3
0.0075	=	5	0.7750	=	5	5	=	0.46452	3	=	2.5084	1.5444	=	4
0.00930	=	6	0.9300	=	6	6	=	0.55742	3.5880	=	3	1.9305	=	5
0.01085	=	7	1	=	6.452	7	=	0.65032	4	=	3.3445	2	=	5.1800
0.01240	=	8	1.0850	=	7	8	=	0.74323	4.7839	=	4	2.3166	=	6
0.01395	=	9	1.2400	=	8	9	=	0.83613	5	=	4.1807	2.7027	=	7
1	=	645.16	1.3950	=	9	10.764	=	1	5.9799	=	5	3	=	7.7700
2	=	1,290.33	2	=	12.903	21.528	=	2	6	=	5.0168	3.0888	=	8
3	=	1,935.49	3	=	19.355	32.292	=	3	7	=	5.8529	3.4749	=	9
4	=	2,580.65	4	=	25.807	43.055	=	4	7.1759	=	6	4	=	10.3600
5	=	3,225.81	5	=	32.258	53.819	=	5	8	=	6.6890	5	=	12.9500
6	=	3,870.98	6	=	38.710	64.583	=	6	8.3719	=	7	6	=	15.5400
7	=	4,516.14	7	=	45.161	75.347	=	7	9	=	7.5252	7	=	18.1300
8	=	5,161.30	8	=	51.613	86.111	=	8	9.5679	=	8	8	=	20.7200
9	=	5,806.46	9	=	58.065	96.875	=	9	10.7639	=	9	9	=	23.3100

COMPARISON OF METRIC AND CUSTOMARY UNITS FROM 1 TO 10—Continued

Volume

CUBIC INCHES	CUBIC MILLIMETERS	CUBIC INCHES	CUBIC CENTIMETERS	CUBIC FEET	CUBIC METERS	CUBIC YARDS	CUBIC METERS
0.000061 =	1	0.0610 =	1	1	= 0.02832	1	= 0.7646
0.000122 =	2	0.1220 =	2	2	= 0.05663	1.3079	= 1
0.000183 =	3	0.1831 =	3	3	= 0.08495	2	= 1.5291
0.000244 =	4	0.2441 =	4	4	= 0.11327	2.6159	= 2
0.000305 =	5	0.3051 =	5	5	= 0.14159	3	= 2.2937
0.000366 =	6	0.3661 =	6	6	= 0.16990	3.9238	= 3
0.000427 =	7	0.4272 =	7	7	= 0.19822	4	= 3.0582
0.000488 =	8	0.4882 =	8	8	= 0.22654	5	= 3.8228
0.000549 =	9	0.5492 =	9	9	= 0.25485	5.2318	= 4
1	= 16,387.2	1	= 16.3872	35.314	= 1	6	= 4.5874
2	= 32,774.3	2	= 32.7743	70.629	= 2	6.5397	= 5
3	= 49,161.5	3	= 49.1615	105.943	= 3	7	= 5.3519
4	= 65,548.6	4	= 65.5486	141.258	= 4	7.8477	= 6
5	= 81,935.8	5	= 81 9358	176.572	= 5	8	= 6.1165
6	= 98,323.0	6	= 98.3230	211.887	= 6	9	= 6.8810
7	= 114,710.1	7	= 114.7101	247.201	= 7	9.1556	= 7
8	= 131,097.3	8	= 131.0973	282.516	= 8	10.4635	= 8
9	= 147,484.5	9	= 147.4845	317.830	= 9	11.7715	= 9

AREA—Continued

ACRES	HECTARES
1	= 0.4047
2	= 0.8094
2.471	= 1
3	= 1.2141
4	= 1.6187
4.942	= 2
5	= 2.0234
6	= 2.4281
7	= 2.8328
7.413	= 3
8	= 3.2375
9	= 3.6422
9.884	= 4
12.355	= 5
14.826	= 6
17.297	= 7
19.768	= 8
22.239	= 9

COMPARISON OF METRIC AND CUSTOMARY UNITS FROM 1 TO 10—Continued

Capacity

MILLILITERS (CC.)	U. S. LIQUID OUNCES	MILLILITERS (CC.)	U. S. APOTHECARIES' DRAMS	U. S. APOTHECARIES' SCRUPLES	MILLILITERS (CC.)	U. S. LIQUID QUARTS	LITERS	U. S. LIQUID GALLONS	LITERS
1	= 0.03381	1	= 0.2705	0.8115	= 1	1	= 0.94636	0.26417	= 1
2	= 0.06763	2	= 0.5410	1	= 1.2322	1.05668	= 1	0.52834	= 2
3	= 0.10144	3	= 0.8115	1.6231	= 2	2	= 1.89272	0.79251	= 3
4	= 0.13526	3.6967	= 1	2	= 2.4645	2.11336	= 2	1	= 3.78543
5	= 0.16907	4	= 1.0820	2.4346	= 3	3	= 2.83908	1.05668	= 4
6	= 0.20288	5	= 1.3525	3	= 3.6967	3.17005	= 3	1.32085	= 5
7	= 0.23670	6	= 1.6231	3.2461	= 4	4	= 3.78543	1.58502	= 6
8	= 0.27051	7	= 1.8936	4	= 4.9290	4.22673	= 4	1.84919	= 7
9	= 0.30432	7.3934	= 2	4.0577	= 5	5	= 4.73179	2	= 7.57087
29.574	= 1	8	= 2.1641	4.8692	= 6	5.28341	= 5	2.11336	= 8
59.147	= 2	9	= 2.4346	5	= 6.1612	6	= 5.67815	2.37753	= 9
88.721	= 3	11.0901	= 3	5.6807	= 7	6.34009	= 6	3	= 11.35630
118.295	= 4	14.7869	= 4	6	= 7.3934	7	= 6.62451	4	= 15.14174
147.869	= 5	18.4836	= 5	6.4923	= 8	7.39677	= 7	5	= 18.92717
177.442	= 6	22.1803	= 6	7	= 8.6257	8	= 7.57088	6	= 22.71261
207.016	= 7	25.8770	= 7	7.3038	= 9	8.45345	= 8	7	= 26.49804
236.590	= 8	29.5737	= 8	8	= 9.8579	9	= 8.51723	8	= 30.28348
266.163	= 9	33.2704	= 9	9	= 11.0901	9.51014	= 9	9	= 34.06891

COMPARISON OF METRIC AND CUSTOMARY UNITS FROM 1 TO 10—Continued

U. S. DRY QUARTS		LITERS	U. S. PECKS		LITERS	DEKA-LITERS		U. S. PECKS.	U. S. BUSHELS		HECTO-LITERS	U. S. BUSHELS PER ACRE		HECTO-LITERS PER HECTARE
0.9081	=	1	0.11351	=	1	0.8810	=	1	1	=	0.35239	1	=	0.87078
1	=	1.1012	0.22702	=	2	1	=	1.1351	2	=	0.70479	1.14840	=	1
1.8162	=	2	0.34053	=	3	1.7620	=	2	2.83774	=	1	2	=	1.74156
2	=	2.2025	0.45404	=	4	2	=	2.2702	3	=	1.05718	2.29680	=	2
2.7242	=	3	0.56755	=	5	2.6429	=	3	4	=	1.40957	3	=	2.61233
3	=	3.3037	0.68106	=	6	3	=	3.4053	5	=	1.76196	3.44519	=	3
3.6323	=	4	0.79457	=	7	3.5239	=	4	5.67548	=	2	4	=	3.48311
4	=	4.4049	0.90808	=	8	4	=	4.5404	6	=	2.11436	4.59359	=	4
4.5404	=	5	1	=	8.80982	4.4049	=	5	7	=	2.46675	5	=	4.35389
5	=	5.5061	1.02157	=	9	5	=	5.6755	8	=	2.81914	5.74199	=	5
5.4485	=	6	2	=	17.61964	5.2859	=	6	8.51323	=	3	6	=	5.22467
6	=	6.6074	3	=	26.42946	6	=	6.8106	9	=	3.17154	6.89039	=	6
6.3565	=	7	4	=	35.23928	6.1669	=	7	11.35097	=	4	7	=	6.09545
7	=	7.7086	5	=	44.04910	7	=	7.9457	14.18871	=	5	8	=	6.96622
7.2646	=	8	6	=	52.85892	7.0479	=	8	17.02645	=	6	8.03879	=	7
8	=	8.8098	7	=	61.66874	7.9288	=	9	19.86420	=	7	9	=	7.83700
8.1727	=	9	8	=	70.47856	8	=	9.0808	22.70194	=	8	9.18719	=	8
9	=	9.9110	9	=	79.28838	9	=	10.2159	25.53968	=	9	10.33558	=	9

COMPARISON OF METRIC AND CUSTOMARY UNITS FROM 1 TO 10—Continued

Weight (or Mass)

GRAINS		GRAMS	AVOIRDUPOIS OUNCES		GRAMS	TROY OUNCES		GRAMS	AVOIRDUPOIS POUNDS		KILOGRAMS	TROY POUNDS		KILOGRAMS
1	=	0.06480	0.03527	=	1	0.03215	=	1	1	=	0.45359	1	=	0.37324
2	=	0.12960	0.07055	=	2	0.06430	=	2	2	=	0.90718	2	=	0.74648
3	=	0.19440	0.10582	=	3	0.09645	=	3	2.20462	=	1	2.67923	=	1
4	=	0.25920	0.14110	=	4	0.12860	=	4	3	=	1.36078	3	=	1.11973
5	=	0.32399	0.17637	=	5	0.16075	=	5	4	=	1.81437	4	=	1.49297
6	=	0.38879	0.21164	=	6	0.19290	=	6	4.40924	=	2	5	=	1.86621
7	=	0.45359	0.24692	=	7	0.22506	=	7	5	=	2.26796	5.35846	=	2
8	=	0.51839	0.28219	=	8	0.25721	=	8	6	=	2.72155	6	=	2.23945
9	=	0.58319	0.31747	=	9	0.28936	=	9	6.61387	=	3	7	=	2.61269
15.4324	=	1	1	=	28.3495	1	=	31.10348	7	=	3.17515	8	=	2.98593
30.8647	=	2	2	=	56.6991	2	=	62.20696	8	=	3.62874	8.03769	=	3
46.2971	=	3	3	=	85.0486	3	=	93.31044	8.81849	=	4	9	=	3.35918
61.7294	=	4	4	=	113.3981	4	=	124.41392	9	=	4.08233	10.71691	=	4
77.1618	=	5	5	=	141.7476	5	=	155.51740	11.02311	=	5	13.39614	=	5
92.5941	=	6	6	=	170.0972	6	=	186.62088	13.22773	=	6	16.07537	=	6
108.0265	=	7	7	=	198.4467	7	=	217.72437	15.43236	=	7	18.75460	=	7
123.4589	=	8	8	=	226.7962	8	=	248.82785	17.63698	=	8	21.43383	=	8
138.8912	=	9	9	=	255.1457	9	=	279.93133	19.84160	=	9	24.11306	=	9

COMPARISON OF THE VARIOUS TONS AND POUNDS IN USE IN THE UNITED STATES

From 1 *to* 10 *Units*

Long tons	Short tons	Metric tons	Kilograms	Avoirdupois pounds	Troy pounds
0.00036735	0.00041143	0.00037324	0.37324	0.822857	1.
0.00044643	0.00050000	0.00045359	0.45359	1.	1.21528
0.00073469	0.00082286	0.00074648	0.74648	1.64571	2.
0.00089286	0.00100000	0.00090718	0.90718	2.	2.43056
0.00098421	0.00110231	0.00100000	1.	2.20462	2.67923
0.00110204	0.00123429	0.00111973	1.11973	2.46857	3.
0.00133929	0.00150000	0.00136078	1.36078	3.	3.64583
0.00146939	0.00164571	0.00149297	1.49297	3.29143	4.
0.00178571	0.00200000	0.00181437	1.81437	4.	4.86111
0.00183673	0.00205714	0.00186621	1.86621	4.11429	5.
0.00196841	0.00220462	0.00200000	2.	4.40924	5.35846
0.00220408	0.00246857	0.00223945	2.23945	4.93714	6.
0.00223214	0.00250000	0.00226796	2.26796	5.	6.07639
0.00257143	0.00288000	0.00261269	2.61269	5.76000	7.
0.00267857	0.00300000	0.00272155	2.72155	6.	7.29167
0.00293878	0.00329143	0.00298593	2.98593	6.58286	8.
0.00295262	0.00330693	0.00300000	3.	6.61387	8.03769
0.00312500	0.00350000	0.00317515	3.17515	7.	8.50694
0.00330612	0.00370286	0.00335918	3.35918	7.40571	9.
0.00357143	0.00400000	0.00362874	3.62874	8.	9.72222

COMPARISON OF THE VARIOUS TONS AND POUNDS IN USE IN THE UNITED STATES (Continued)

From 1 *to* 10 *Units*

Long tons	Short tons	Metric tons	Kilograms	Avoirdupois pounds	Troy pounds
0.00393683	0.00440924	0.00400000	4.	8.81849	10.71691
0.00401786	0.00450000	0.00408233	4.08233	9.	10.93750
0.00492103	0.00551156	0.00500000	5.	11.0231	13.39614
0.00590524	0.00661387	0.00600000	6.	13.2277	16.07537
0.00688944	0.00771618	0.00780000	7.	15.4324	18.75460
0.00787365	0.00881849	0.00800000	8.	17.6370	21.43383
0.00885786	0.00992080	0.00900000	9.	19.8416	24.11306
0.89287	1.	0.9718	907.18	2,000.	2,430.56
0.98421	1.10231	1.	1,000.	2,204.62	2,679.23
1.	1.12000	1.01605	1,016.05	2,240.00	2,722.22
1.78571	2.	1.81437	1,814.37	4,000.00	4,861.11
1.96841	2.20462	2.	2,000.00	4,409.24	5,358.46
2.	2.24000	2.03209	2,032.09	4,480.00	5,444.44
2.67857	3.	2.72155	2,721.55	6,000.00	7,291.67
2.95262	3.30693	3.	3,000.00	6,613.87	8,037.69
3.	3.36000	3.04814	3,048.14	6,720.00	8,166.67
3.57143	4.	3.62874	3,628.74	8,000.00	9,722.22
3.93683	4.40924	4.	4,000.00	8,818.49	10,716.91
4.	4.48000	4.06419	4,064.19	8,960.00	10,888.89
4.46429	5.	4.53592	4,535.92	10,000.00	12,152.78

COMPARISON OF THE VARIOUS TONS AND POUNDS IN USE IN THE UNITED STATES (Continued)

Long tons	Short tons	Metric tons	Kilograms	Avoirdupois pounds	Troy pounds
4.92103	5.51156	5.	5,000.00	11,023.11	13,396.14
5.	5.60000	5.08024	5,080.24	11,200.00	13,611.11
5.35714	6.	5.44311	5,443.11	12,000.00	14,583.33
5.90524	6.61387	6.	6,000.00	13,227.73	16,075.37
6.	6.72000	6.09628	6,096.28	13,440.00	16,333.33
6.25000	7.	6.35029	6,350.29	14,000.00	17,013.89
6.88944	7.71618	7.	7,000.00	15,432.36	18,754.60
7.	7.84000	7.11232	7,112.32	15,680.00	19,055.56
7.14286	8.	7.25748	7,257.48	16,000.00	19,444.44
7.87365	8.81849	8.	8,000.00	17,636.98	21,433.83
8.	8.96000	8.12838	8,128.38	17,920.00	21,777.78
8.03571	9.	8.16466	8,164.66	18,000.00	21,875.00
8.85786	9.92080	9.	9,000.00	19,841.60	24,113.06
9.	10.08000	9.14442	9,144.42	20,160.00	24,500.00

LENGTHS — CENTIMETERS TO INCHES

0.1 *to* 100 *Units*

1 centimeter = 0.393700 inches

The values found in the body of the table give, in inches, the lengths indicated in centimeters at the top and side.

	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
0		0.03937	0.07874	0.11811	0.15748	0.19685	0.23622	0.27559	0.31496	0.35433
1	0.39370	0.43307	0.47244	0.51181	0.55118	0.59055	0.62992	0.66929	0.70866	0.74803
2	0.78740	0.82677	0.86614	0.90551	0.94488	0.98425	1.0236	1.0630	1.1024	1.1417
3	1.1811	1.2205	1.2598	1.2992	1.3386	1.3780	1.4173	1.4567	1.4961	1.5354
4	1.5748	1.6142	1.6535	1.6929	1.7323	1.7717	1.8110	1.8504	1.8898	1.9291
5	1.9685	2.0079	2.0472	2.0866	2.1260	2.1654	2.2047	2.2441	2.2835	2.3228
6	2.3622	2.4016	2.4409	2.4803	2.5197	2.5591	2.5984	2.6378	2.6772	2.7165
7	2.7559	2.7953	2.8346	2.8740	2.9134	2.9528	2.9921	3.0315	3.0709	3.1102
8	3.1496	3.1890	3.2283	3.2677	3.3071	3.3465	3.3858	3.4252	3.4646	3.5039
9	3.5433	3.5827	3.6220	3.6614	3.7008	3.7402	3.7795	3.8189	3.8583	3.8976

LENGTHS — CENTIMETERS TO INCHES (Continued)

	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
10	3.9370	3.9764	4.0158	4.0551	4.0945	4.1339	4.1732	4.2126	4.2520	4.2913
11	4.3307	4.3701	4.4094	4.4488	4.4882	4.5276	4.5669	4.6063	4.6457	4.6850
12	4.7244	4.7638	4.8031	4.8425	4.8819	4.9213	4.9606	5.0000	5.0394	5.0787
13	5.1181	5.1575	5.1968	5.2362	5.2756	5.3150	5.3543	5.3937	5.4331	5.4724
14	5.5118	5.5512	5.5905	5.6299	5.6693	5.7087	5.7480	5.7874	5.8268	5.8661
15	5.9055	5.9449	5.9842	6.0236	6.0630	6.1024	6.1417	6.1811	6.2205	6.2598
16	6.2992	6.3386	6.3779	6.4173	6.4567	6.4961	6.5354	6.5748	6.6142	6.6535
17	6.6929	6.7323	6.7716	6.8110	6.8504	6.8898	6.9291	6.9685	7.0079	7.0472
18	7.0866	7.1260	7.1653	7.2047	7.2441	7.2835	7.3228	7.3622	7.4016	7.4409
19	7.4803	7.5197	7.5590	7.5984	7.6378	7.6772	7.7165	7.7559	7.7953	7.8346
20	7.8740	7.9134	7.9527	7.9921	8.0315	8.0709	8.1102	8.1496	8.1890	8.2283
21	8.2677	8.3071	8.3464	8.3858	8.4252	8.4646	8.5039	8.5433	8.5827	8.6220
22	8.6614	8.7008	8.7401	8.7795	8.8189	8.8583	8.8976	8.9370	8.9764	9.0157
23	9.0551	9.0945	9.1338	9.1732	9.2126	9.2520	9.2913	9.3307	9.3701	9.4094
24	9.4488	9.4882	9.5275	9.5669	9.6063	9.6457	9.6850	9.7244	9.7638	9.8031
25	9.8425	9.8819	9.9212	9.9606	10.000	10.039	10.079	10.118	10.157	10.197
26	10.236	10.276	10.315	10.354	10.394	10.433	10.472	10.512	10.551	10.591
27	10.630	10.669	10.709	10.748	10.787	10.827	10.866	10.905	10.945	10.984
28	11.024	11.063	11.102	11.142	11.181	11.220	11.260	11.299	11.339	11.378
29	11.417	11.457	11.496	11.535	11.575	11.614	11.654	11.693	11.732	11.772

LENGTHS — CENTIMETERS TO INCHES (Continued)

	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
30	11.811	11.850	11.890	11.929	11.968	12.008	12.047	12.087	12.126	12.165
31	12.205	12.244	12.283	12.323	12.362	12.402	12.441	12.480	12.520	12.559
32	12.598	12.638	12.677	12.717	12.756	12.795	12.835	12.874	12.914	12.953
33	12.992	13.031	13.071	13.110	13.150	13.189	13.228	13.268	13.307	13.346
34	13.386	13.425	13.465	13.504	13.543	13.583	13.622	13.661	13.701	13.740
35	13.780	13.819	13.858	13.898	13.937	13.976	14.016	14.055	14.094	14.134
36	14.173	14.213	14.252	14.291	14.331	14.370	14.409	14.449	14.488	14.528
37	14.567	14.606	14.646	14.685	14.724	14.764	14.803	14.842	14.882	14.921
38	14.961	15.000	15.039	15.079	15.118	15.157	15.197	15.236	15.276	15.315
39	15.354	15.394	15.433	15.472	15.512	15.551	15.591	15.630	15.669	15.709
40	15.748	15.787	15.827	15.866	15.905	15.945	15.984	16.024	16.063	16.102
41	16.142	16.181	16.220	16.260	16.299	16.339	16.378	16.417	16.457	16.496
42	16.535	16.575	16.614	16.654	16.693	16.732	16.772	16.811	16.850	16.890
43	16.929	16.968	17.008	17.047	17.087	17.126	17.165	17.205	17.244	17.283
44	17.323	17.362	17.402	17.441	17.480	17.520	17.559	17.598	17.638	17.677
45	17.717	17.756	17.795	17.835	17.874	17.913	17.953	17.992	18.031	18.071
46	18.110	18.150	18.189	18.228	18.268	18.307	18.346	18.386	18.425	18.465
47	18.504	18.543	18.583	18.622	18.661	18.701	18.740	18.779	18.819	18.858
48	18.898	18.987	18.976	19.016	19.055	19.094	19.134	19.173	19.213	19.252
49	19.291	19.331	19.370	19.409	19.449	19.488	19.528	19.567	19.606	19.646

LENGTHS — CENTIMETERS TO INCHES (Continued)

	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
50	19.685	19.724	19.764	19.803	19.842	19.882	19.921	19.961	20.000	20.039
51	20.079	20.118	20.157	20.197	20.236	20.276	20.315	20.354	20.394	20.433
52	20.472	20.512	20.551	20.591	20.630	20.669	20.709	20.748	20.787	20.827
53	20.866	20.905	20.945	20.984	21.024	21.063	21.102	21.142	21.181	21.220
54	21.260	21.299	21.339	21.378	21.417	21.457	21.496	21.535	21.575	21.614
55	21.654	21.693	21.732	21.772	21.811	21.850	21.890	21.929	21.968	22.008
56	22.047	22.087	22.126	22.165	22.205	22.244	22.283	22.323	22.362	22.402
57	22.441	22.480	22.520	22.559	22.598	22.638	22.677	22.716	22.756	22.795
58	22.835	22.874	22.913	22.953	22.992	23.031	23.071	23.110	23.150	23.189
59	23.228	23.268	23.307	23.346	23.386	23.425	23.465	23.504	23.543	23.583
60	23.622	23.661	23.701	23.740	23.779	23.819	23.858	23.898	23.937	23.976
61	24.016	24.055	24.094	24.134	24.173	24.213	24.252	24.291	24.331	24.370
62	24.409	24.449	24.488	24.528	24.567	24.606	24.646	24.685	24.724	24.764
63	24.803	24.842	24.882	24.921	24.961	25.000	25.039	25.079	25.118	25.157
64	25.197	25.236	25.276	25.315	25.354	25.394	25.433	25.472	25.512	25.551
65	25.591	25.630	25.669	25.709	25.748	25.787	25.827	25.866	25.905	25.945
66	25.984	26.024	26.063	26.102	26.142	26.181	26.220	26.260	26.299	26.339
67	26.378	26.417	26.457	26.496	26.535	26.575	26.614	26.653	26.693	26.732
68	26.772	26.811	26.850	26.890	26.929	26.968	27.008	27.047	27.087	27.126
69	27.165	27.205	27.244	27.283	27.323	27.362	27.402	27.441	27.480	27.520

LENGTHS — CENTIMETERS TO INCHES (Continued)

	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
70	27.559	27.598	27.638	27.677	27.716	27.756	27.795	27.835	27.874	27.913
71	27.953	27.992	28.031	28.071	28.110	28.150	28.189	28.228	28.268	28.307
72	28.346	28.386	28.425	28.465	28.504	28.543	28.583	28.622	28.661	28.701
73	28.740	28.779	28.819	28.858	28.898	28.937	28.976	29.016	29.055	29.094
74	29.134	29.173	29.213	29.252	29.291	29.331	29.370	29.409	29.449	29.488
75	29.528	29.567	29.606	29.646	29.685	29.724	29.764	29.803	29.842	29.882
76	29.921	29.961	30.000	30.039	30.079	30.118	30.157	30.197	30.236	30.276
77	30.315	30.354	30.394	30.433	30.472	30.512	30.551	30.590	30.630	30.669
78	30.709	30.748	30.787	30.827	30.866	30.905	30.945	30.984	31.024	31.063
79	31.102	31.142	31.181	31.220	31.260	31.299	31.339	31.378	31.417	31.457
80	31.496	31.535	31.575	31.614	31.653	31.693	31.732	31.772	31.811	31.850
81	31.890	31.929	31.968	32.008	32.047	32.087	32.126	32.165	32.205	32.244
82	32.283	32.323	32.362	32.402	32.441	32.480	32.520	32.559	32.598	32.638
83	32.677	32.716	32.756	32.795	32.835	32.874	32.913	32.953	32.992	33.031
84	33.071	33.110	33.150	33.189	33.228	33.268	33.307	33.346	33.386	33.425
85	33.465	33.504	33.543	33.583	33.622	33.661	33.701	33.740	33.779	33.819
86	23.858	33.898	33.937	33.976	33.016	34.055	34.094	34.134	34.173	34.213
87	34.252	34.291	34.331	34.370	34.409	34.449	34.488	34.527	34.567	34.606
88	34.646	34.685	34.724	34.764	34.803	34.842	34.882	34.921	34.961	35.000
89	35.039	35.079	35.118	35.157	35.197	35.236	35.276	35.315	35.354	35.394

LENGTHS — CENTIMETERS TO INCHES (Continued)

	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
90	35.433	35.472	35.512	35.551	35.590	35.630	35.669	35.709	35.748	35.787
91	35.827	35.866	35.905	35.945	35.984	36.024	36.063	36.102	36.142	36.181
92	36.220	36.260	36.299	36.339	36.378	36.417	36.457	36.496	36.535	36.575
93	36.614	36.653	36.693	36.732	36.772	36.811	36.850	36.890	36.929	36.968
94	37.008	37.047	37.087	37.126	37.165	37.205	37.244	37.283	37.323	37.362
95	37.402	37.441	37.480	37.520	37.559	37.598	37.638	37.677	37.716	37.756
96	37.795	37.835	37.874	37.913	37.953	37.992	38.031	38.071	38.110	38.150
97	38.189	38.228	38.268	38.307	38.346	38.386	38.425	38.464	38.504	38.543
98	38.583	38.622	38.661	38.701	38.740	38.779	38.819	38.858	38.898	38.937
99	38.976	39.016	39.055	39.094	39.134	39.173	39.213	39.252	39.291	39.331

LENGTHS — INCHES TO CENTIMETERS

From 0.1 *to* 100 *Units*

1 inch = 2.54001 centimeters

The values found in the body of the table give, in centimeters, the lengths indicated in inches at the top and side.

	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
0	.....	0.25400	0.50800	0.76200	1.0160	1.2700	1.5240	1.7780	2.0320	2.2860
1	2.5400	2.7940	3.0480	3.3020	3.5560	3.8100	4.0640	4.3180	4.5720	4.8260
2	5.0800	5.3340	5.5880	5.8420	6.0960	6.3500	6.6040	6.8580	7.1120	7.3660
3	7.6200	7.8740	8.1280	8.3820	8.6360	8.8900	9.1440	9.3980	9.6520	9.9060
4	10.160	10.414	10.668	10.922	11.176	11.430	11.684	11.938	12.192	12.446
5	12.700	12.954	13.208	13.462	13.716	13.970	14.224	14.478	14.732	14.986
6	15.240	15.494	15.748	16.002	16.256	16.510	16.764	17.018	17.272	17.526
7	17.780	18.034	18.288	18.542	18.796	19.050	19.304	19.558	19.812	20.066
8	20.320	20.574	20.828	21.082	21.336	21.590	21.844	22.098	22.352	22.606
9	22.860	23.114	23.368	23.622	23.876	24.130	24.384	24.638	24.892	25.146

LENGTHS — INCHES TO CENTIMETERS (Continued)

	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
10	25.400	25.654	25.908	26.162	26.416	26.670	26.924	27.178	27.432	27.686
11	27.940	28.194	28.448	28.702	28.956	29.210	29.464	29.718	29.972	30.226
12	30.480	30.734	30.988	31.242	31.496	31.750	32.004	32.258	32.512	32.766
13	33.020	33.274	33.528	33.782	34.036	34.290	34.544	34.798	35.052	35.306
14	35.560	35.814	36.068	36.322	36.576	36.830	37.084	37.338	37.592	37.846
15	38.100	38.354	38.608	38.862	39.116	39.370	39.624	39.878	40.132	40.386
16	40.640	40.894	41.148	41.402	41.656	41.910	42.164	42.418	42.672	42.926
17	43.180	43.434	43.688	43.942	44.196	44.450	44.704	44.958	45.212	45.466
18	45.720	45.974	46.228	46.482	46.736	46.990	47.244	47.498	47.752	48.006
19	48.260	48.514	48.768	49.022	49.276	49.530	49.784	50.038	50.292	50.546
20	50.800	51.054	51.308	51.562	51.816	52.070	52.324	52.578	52.832	53.086
21	53.340	53.594	53.848	54.102	54.356	54.610	54.864	55.118	55.372	55.626
22	55.880	56.134	56.388	56.642	56.896	57.150	57.404	57.658	57.912	58.166
23	58.420	58.674	58.928	59.182	59.436	59.690	59.944	60.198	60.452	60.706
24	60.960	61.214	61.468	61.722	61.976	62.230	62.484	62.738	62.992	63.246
25	63.500	63.754	64.008	64.262	64.516	64.770	65.024	65.278	65.532	65.786
26	66.040	66.294	66.548	66.802	67.056	67.310	67.564	67.818	68.072	68.326
27	68.580	68.834	69.088	69.342	69.596	69.850	70.104	70.358	70.612	70.866
28	71.120	71.374	71.628	71.882	72.136	72.390	72.644	72.898	73.152	73.406
29	73.660	73.914	74.168	74.422	74.676	74.930	75.184	75.438	75.692	75.946

LENGTHS — INCHES TO CENTIMETERS (Continued)

	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
30	76.200	76.454	76.708	76.962	77.216	77.470	77.724	77.978	78.232	78.486
31	78.740	78.994	79.248	79.502	79.756	80.010	80.264	80.518	80.772	81.026
32	81.280	81.534	81.788	82.042	82.296	82.550	82.804	83.058	83.312	83.566
33	83.820	84.074	84.328	84.582	84.836	85.090	85.344	85.598	85.852	86.106
34	86.360	86.614	86.868	87.122	87.376	87.630	87.884	88.138	88.392	88.646
35	88.900	89.154	89.408	89.662	89.916	90.170	90.424	90.678	90.932	91.186
36	91.440	91.694	91.948	92.202	92.456	92.710	92.964	93.218	93.472	93.726
37	93.980	94.234	94.488	94.742	94.996	95.250	95.504	95.758	96.012	96.266
38	96.520	96.774	97.028	97.282	97.536	97.790	98.044	98.298	98.552	98.806
39	99.060	99.314	99.568	99.822	100.08	100.33	100.58	100.84	101.09	101.35
40	101.60	101.85	102.11	102.36	102.62	102.87	103.12	103.38	103.63	103.89
41	104.14	104.39	104.65	104.90	105.16	105.41	105.66	105.92	106.17	106.43
42	106.68	106.93	107.19	107.44	107.70	107.95	108.20	108.46	108.71	108.97
43	109.22	109.47	109.73	109.98	110.24	110.49	110.74	111.00	111.25	111.51
44	111.76	112.01	112.27	112.52	112.78	113.03	113.28	113.54	113.79	114.05
45	114.30	114.55	114.81	115.06	115.32	115.57	115.82	116.08	116.33	116.59
46	116.84	117.09	117.35	117.60	117.86	118.11	118.36	118.62	118.87	119.13
47	119.38	119.63	119.89	120.14	120.40	120.65	120.90	121.16	121.41	121.67
48	121.92	122.17	122.43	122.68	122.94	123.19	123.44	123.70	123.95	124.21
49	124.46	124.71	124.97	125.22	125.48	125.73	125.98	126.24	126.49	126.75

LENGTHS — INCHES TO CENTIMETERS (Continued)

	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
50	127.00	127.25	127.51	127.76	128.02	128.27	128.52	128.78	129.03	129.29
51	129.54	129.79	130.05	130.30	130.56	130.81	131.06	131.32	131.57	131.83
52	132.08	132.33	132.59	132.84	133.10	133.35	133.60	133.86	134.11	134.37
53	134.62	134.87	135.13	135.38	135.64	135.89	136.14	136.40	136.65	136.91
54	137.16	137.41	137.67	137.92	138.18	138.43	138.68	138.94	139.19	139.45
55	139.70	139.95	140.21	140.46	140.72	140.97	141.22	141.48	141.73	141.99
56	142.24	142.49	142.75	143.00	143.26	143.51	143.76	144.02	144.27	144.53
57	144.78	145.03	145.29	145.54	145.80	146.05	146.30	146.56	146.81	147.07
58	147.32	147.57	147.83	148.08	148.34	148.59	148.84	149.10	149.35	149.61
59	149.86	150.11	150.37	150.62	150.88	151.13	151.38	151.64	151.89	152.15
60	152.40	152.65	152.91	153.16	153.42	153.67	153.92	154.18	154.43	154.69
61	154.94	155.19	155.45	155.70	155.96	156.21	156.46	156.72	156.97	157.23
62	157.48	157.73	157.99	158.24	158.50	158.75	159.00	159.26	159.51	159.77
63	160.02	160.27	160.53	160.78	161.04	161.29	161.54	161.80	162.05	162.31
64	162.56	162.81	163.07	163.32	163.58	163.83	164.08	164.34	164.59	164.85
65	165.10	165.35	165.61	165.86	166.12	166.37	166.62	166.88	167.13	167.39
66	167.64	167.89	168.15	168.40	168.66	168.91	169.16	169.42	169.67	169.93
67	170.18	170.43	170.69	170.94	171.20	171.45	171.70	171.96	172.21	172.47
68	172.72	172.97	173.23	173.48	173.74	173.99	174.24	174.50	174.75	175.01
69	175.26	175.51	175.77	176.02	176.28	176.53	176.78	177.04	177.29	177.55

LENGTHS — INCHES TO CENTIMETERS (Continued)

	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
70	177.80	178.05	178.31	178.56	178.82	179.07	179.32	179.58	179.83	180.09
71	180.34	180.59	180.85	181.10	181.36	181.61	181.86	182.12	182.37	182.63
72	182.88	183.13	183.39	183.64	183.90	184.15	184.40	184.66	184.91	185.17
73	185.42	185.67	185.93	186.18	186.44	186.69	186.94	187.20	187.45	187.71
74	187.96	188.21	188.47	188.72	188.98	189.23	189.48	189.74	189.99	190.25
75	190.50	190.75	191.01	191.26	191.52	191.77	192.02	192.28	192.53	192.79
76	193.04	193.29	193.55	193.80	194.06	194.31	194.56	194.82	195.07	195.33
77	195.58	195.83	196.09	196.34	196.60	196.85	197.10	197.36	197.61	197.87
78	198.12	198.37	198.63	198.88	199.14	199.39	199.64	199.90	200.15	200.41
79	200.66	200.91	201.17	201.42	201.68	201.93	202.18	202.44	202.69	202.95
80	203.20	203.45	203.71	203.96	204.22	204.47	204.72	204.98	205.23	205.49
81	205.74	205.99	206.25	206.50	206.76	207.01	207.26	207.52	207.77	208.03
82	208.28	208.53	208.79	209.04	209.30	209.55	209.80	210.06	210.31	210.57
83	210.82	211.07	211.33	211.58	211.84	212.09	212.34	212.60	212.85	213.11
84	213.36	213.61	213.87	214.12	214.38	214.63	214.88	215.14	215.39	215.65
85	215.90	216.15	216.41	216.66	216.92	217.17	217.42	217.68	217.93	218.19
86	218.44	218.69	218.95	219.20	219.46	219.71	219.96	220.22	220.47	220.73
87	220.98	221.23	221.49	221.74	222.00	222.25	222.50	222.76	223.01	223.27
88	223 52	223.77	224.03	224.28	224.54	224.79	225.04	225.30	225.55	225.81
89	226.06	226.31	226.57	226.82	227.08	227.33	227.58	227.84	228.09	228.35

LENGTHS — INCHES TO CENTIMETERS (Continued)

	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
90	228.60	228.85	229.11	229.36	229.62	229.87	230.12	230.38	230.63	230.89
91	231.14	231.39	231.65	231.90	232.16	232.41	232.66	232.92	233.17	233.43
92	233.68	233.93	234.19	234.44	234.70	234.95	235.20	235.46	235.71	235.97
93	236.22	236.47	236.73	236.98	237.24	237.49	237.74	238.00	238.25	238.51
94	238.76	239.01	239.27	239.52	239.78	240.03	240.28	240.54	240.79	241.05
95	241.30	241.55	241.81	242.06	242.32	242.57	242.82	243.08	243.33	243.59
96	243.84	246.09	244.35	244.60	244.86	245.11	245.36	245.62	245.87	246.13
97	246.38	246.63	246.89	247.14	247.40	247.65	247.90	248.16	248.41	248.67
98	248.92	249.17	249.43	249.68	249.94	250.19	250.44	250.70	250.95	251.21
99	251.46	251.71	251.97	252.22	252.48	252.73	252.98	253.24	253.49	253.75

LENGTHS — METERS TO FEET

From 1 *to* 1,000 *Units*

Reduction factor: 1 meter = 3.280833333 feet

The values found in the body of the table give, in feet, the length indicated in meters at the top and side.

	0	1	2	3	4	5	6	7	8	9
0	.....	3.2808	6.5617	9.8425	13.123	16.404	19.685	22.966	26.247	29.527
10	32.808	36.089	39.370	42.651	45.932	49.212	52.493	55.774	59.055	62.336
20	65.617	68.897	72.178	75.459	78.740	82.021	85.302	88.583	91.863	95.144
30	98.425	101.71	104.99	108.27	111.55	114.83	118.11	121.39	124.67	127.95
40	131.23	134.51	137.80	141.08	144.36	147.64	150.92	154.20	157.48	160.76
50	164.04	167.32	170.60	173.88	177.16	180.45	183.73	187.01	190.29	193.57
60	196.85	200.13	203.41	206.69	209.97	213.25	216.53	219.82	223.10	226.38
70	229.66	232.94	236.22	239.50	242.78	246.06	249.34	252.62	255.90	259.19
80	262.47	265.75	269.03	272.31	275.59	278.87	282.15	285.43	288.71	291.99
90	295.27	298.56	301.84	305.12	308.40	311.68	314.96	318.23	321.52	324.80

LENGTHS — METERS TO FEET (Continued)

	0	1	2	3	4	5	6	7	8	9
100	328.08	331.36	334.64	337.93	341.21	344.49	347.77	351.05	354.33	357.61
110	360.89	364.17	367.45	370.73	374.01	377.30	380.58	383.86	387.14	390.42
120	393.70	396.98	400.26	403.54	406.82	410.10	413.38	416.67	419.95	423.23
130	426.51	429.79	433.07	436.35	439.63	442.91	446.19	449.47	452.75	456.04
140	459.32	462.60	465.88	469.16	472.44	475.72	479.00	482.28	485.56	488.84
150	492.12	495.41	498.69	501.97	505.25	508.53	511.81	515.09	518.37	521.65
160	524.93	528.21	531.49	534.78	538.06	541.34	544.62	547.90	551.18	554.46
170	557.74	561.02	564.30	567.58	570.86	574.15	577.43	580.71	583.99	587.27
180	590.55	593.83	597.11	600.39	603.67	606.95	610.23	613.52	616.80	620.08
190	623.36	626.64	629.92	633.20	636.48	639.76	643.04	646.32	649.61	652.89
200	656.17	659.45	662.73	666.01	669.29	672.57	675.85	679.13	682.41	685.69
210	688.97	692.26	695.54	698.82	702.10	705.38	708.66	711.94	715.22	718.50
220	721.78	725.06	728.34	731.63	734.91	738.19	741.47	744.75	748.03	751.31
230	754.59	757.87	761.15	764.43	767.71	771.00	774.28	777.56	780.84	784.12
240	787.40	790.68	793.96	797.24	800.52	803.80	807.08	810.37	813.65	816.93
250	820.21	823.49	826.77	830.05	833.33	836.61	839.89	843.17	846.45	849.74
260	853.02	856.30	859.58	862.86	866.14	869.42	872.70	875.98	879.26	882.54
270	885.82	889.11	892.39	895.67	898.95	902.23	905.51	908.79	912.07	915.35
280	918.63	921.91	925.19	928.48	931.76	935.04	938.32	941.60	944.88	948.16
290	951.44	954.72	958.00	961.28	964.56	967.85	971.13	974.41	977.69	980.97

LENGTHS — METERS TO FEET (Continued)

	0	1	2	3	4	5	6	7	8	9
300	984.25	987.53	990.81	994.09	997.37	1,000.7	1,003.9	1,007.2	1,010.5	1,013.8
310	1,017.1	1,020.3	1,023.6	1,026.9	1,030.2	1,033.5	1,036.7	1,040.0	1,043.3	1,046.6
320	1,049.9	1,053.1	1,056.4	1,059.7	1,063.0	1,066.3	1,069.6	1,072.8	1,076.1	1,079.4
330	1,082.7	1,086.0	1,089.2	1,092.5	1,095.8	1,099.1	1,102.4	1,105.6	1,108.9	1,112.2
340	1,115.5	1,118.8	1,122.0	1,125.3	1,128.6	1,131.9	1,135.2	1,138.4	1,141.7	1,145.0
350	1,148.3	1,151.6	1,154.9	1,158.1	1,161.4	1,164.7	1,168.0	1,171.3	1,174.5	1,177.8
360	1,181.1	1,184.4	1,187.7	1,190.9	1,194.2	1,197.5	1,200.8	1,204.1	1,207.3	1,210.6
370	1,213.9	1,217.2	1,220.5	1,223.8	1,227.0	1,230.3	1,233.6	1,236.9	1,240.2	1,243.4
380	1,246.7	1,250.0	1,253.3	1,256.6	1,259.8	1,263.1	1,266.4	1,269.7	1,273.0	1,276.2
390	1,279.5	1,282.8	1,286.1	1,289.4	1,292.6	1,295.9	1,299.2	1,302.5	1,305.8	1,309.1
400	1,312.3	1,315.6	1,318.9	1,322.2	1,325.5	1,328.7	1,332.0	1,335.3	1,338.6	1,341.9
410	1,345.1	1,348.4	1,351.7	1,355.0	1,358.3	1,361.5	1,364.8	1,368.1	1,371.4	1,374.7
420	1,377.9	1,381.2	1,384.5	1,387.8	1,391.1	1,394.4	1,397.6	1,400.9	1,404.2	1,407.5
430	1,410.8	1,414.0	1,417.3	1,420.6	1,423.9	1,427.2	1,430.4	1,433.7	1,437.0	1,440.3
440	1,443.6	1,446.8	1,450.1	1,453.4	1,456.7	1,460.0	1,463.3	1,466.5	1,469.8	1,473.1
450	1,476.4	1,479.7	1,482.9	1,486.2	1,489.5	1,492.8	1,496.1	1,499.3	1,502.6	1,505.9
460	1,509.2	1,512.5	1,515.7	1,519.0	1,522.3	1,525.6	1,528.9	1,532.1	1,535.4	1,538.7
470	1,542.0	1,545.3	1,548.6	1,551.8	1,555.1	1,558.4	1,561.7	1,565.0	1,568.2	1,571.5
480	1,574.8	1,578.1	1,581.4	1,584.6	1,587.9	1,591.2	1,594.5	1,597.8	1,601.0	1,604.3
490	1,607.6	1,610.9	1,614.2	1,617.5	1,620.7	1,624.0	1,627.3	1,630.6	1,633.9	1,637.1

LENGTHS — METERS TO FEET (Continued)

	0	1	2	3	4	5	6	7	8	9
500	1,640.4	1,643.7	1,647.0	1,650.3	1,653.5	1,656.8	1,660.1	1,663.4	1,666.7	1,669.9
510	1,673.2	1,676.5	1,679.8	1,683.1	1,686.3	1,689.6	1,692.9	1,696.2	1,699.5	1,702.8
520	1,706.0	1,709.3	1,712.6	1,715.9	1,719.2	1,722.4	1,725.7	1,729.0	1,732.3	1,735.6
530	1,738.8	1,742.1	1,745.4	1,748.7	1,752.0	1,755.2	1,758.5	1,761.8	1,765.1	1,768.4
540	1,771.7	1,774.9	1,778.2	1,781.5	1,784.8	1,788.1	1,791.3	1,794.6	1,797.9	1,801.2
550	1,804.5	1,807.7	1,811.0	1,814.3	1,817.6	1,820.9	1,824.1	1,827.4	1,830.7	1,834.0
560	1,837.3	1,840.5	1,843.8	1,847.1	1,850.4	1,853.7	1,857.0	1,860.2	1,863.5	1,866.8
570	1,870.1	1,873.4	1,876.6	1,879.9	1,883.2	1,886.5	1,889.8	1,893.0	1,896.3	1,899.6
580	1,902.9	1,906.2	1,909.4	1,912.7	1,916.0	1,919.3	1,922.6	1,925.8	1,929.1	1,932.4
590	1,935.7	1,939.0	1,942.3	1,945.5	1,948.8	1,952.1	1,955.4	1,958.7	1,961.9	1,965.2
600	1,968.5	1,971.8	1,975.1	1,978.3	1,981.6	1,984.9	1,988.2	1,991.5	1,994.7	1,998.0
610	2,001.3	2,004.6	2,007.9	2,011.2	2,014.4	2,017.7	2,021.0	2,024.3	2,027.6	2,030.8
620	2,034.1	2,037.4	2,040.7	2,044.0	2,047.2	2,050.5	2,053.8	2,057.1	2,060.4	2,063.6
630	2,066.9	2,070.2	2,073.5	2,076.8	2,080.0	2,083.3	2,086.6	2,089.9	2,093.2	2,096.5
640	2,099.7	2,103.0	2,106.3	2,109.6	2,112.9	2,116.1	2,119.4	2,122.7	2,126.0	2,129.3
650	2,132.5	2,135.8	2,139.1	2,142.4	2,145.7	2,148.9	2,152.2	2,155.5	2,158.8	2,162.1
660	2,165.4	2,168.6	2,171.9	2,175.2	2,178.5	2,181.8	2,185.0	2,188.3	2,191.6	2,194.9
670	2,198.2	2,201.4	2,204.7	2,208.0	2,211.3	2,214.6	2,217.8	2,221.1	2,224.4	2,227.7
680	2,231.0	2,234.2	2,237.5	2,240.8	2,244.1	2,247.4	2,250.7	2,253.9	2,257.2	2,260.5
690	2,263.8	2,267.1	2,270.3	2,273.6	2,276.9	2,280.2	2,283.5	2,286.7	2,290.0	2,293.3

LENGTHS — METERS TO FEET (Continued)

	0	1	2	3	4	5	6	7	8	9
700	2,296.6	2,299.9	2,303.1	2,306.4	2,309.7	2,313.0	2,316.3	2,319.5	2,322.8	2,326.1
710	2,329.4	2,332.7	2,336.0	2,339.2	2,342.5	2,345.8	2,349.1	2,352.4	2,355.6	2,358.9
720	2,362.2	2,365.5	2,368.8	2,372.0	2,375.3	2,378.6	2,381.9	2,385.2	2,388.4	2,391.7
730	2,395.0	2,398.3	2,401.6	2,404.9	2,408.1	2,411.4	2,414.7	2,418.0	2,421.3	2,424.5
740	2,427.8	2,431.1	2,434.4	2,437.7	2,440.9	2,444.2	2,447.5	2,450.8	2,454.1	2,457.3
750	2,460.6	2,463.9	2,467.2	2,470.5	2,473.7	2,477.0	2,480.3	2,483.6	2,486.9	2,490.2
760	2,493.4	2,496.7	2,500.0	2,503.3	2,506.6	2,509.8	2,513.1	2,516.4	2,519.7	2,523.0
770	2,526.2	2,529.5	2,532.8	2,536.1	2,539.4	2,542.6	2,545.9	2,549.2	2,552.5	2,555.8
780	2,559.0	2,562.3	2,565.6	2,568.9	2,572.2	2,575.5	2,578.7	2,582.0	2,585.3	2,588.6
790	2,591.9	2,595.1	2,598.4	2,601.7	2,605.0	2,608.3	2,611.5	2,614.8	2,618.1	2,621.4
800	2,624.7	2,627.9	2,631.2	2,634.5	2,637.8	2,641.1	2,644.4	2,647.6	2,650.9	2,654.2
810	2,657.5	2,660.8	2,664.0	2,667.3	2,670.6	2,673.9	2,677.2	2,680.4	2,683.7	2,687.0
820	2,690.3	2,693.6	2,696.8	2,700.1	2,703.4	2,706.7	2,710.0	2,713.2	2,716.5	2,719.8
830	2,723.1	2,726.4	2,729.7	2,732.9	2,736.2	2,739.5	2,742.8	2,746.1	2,749.3	2,752.6
840	2,755.9	2,759.2	2,762.5	2,765.7	2,769.0	2,772.3	2,775.6	2,778.9	2,782.1	2,785.4
850	2,788.7	2,792.0	2,795.3	2,798.6	2,801.8	2,805.1	2,808.4	2,811.7	2,815.0	2,818.2
860	2,821.5	2,824.8	2,828.1	2,831.4	2,834.6	2,827.9	2,841.2	2,844.5	2,847.8	2,851.0
870	2,854.3	2,857.6	2,860.9	2,864.2	2,867.4	2,870.7	2,874.0	2,877.3	2,880.6	2,883.9
880	2,887.1	2,890.4	2,893.7	2,897.0	2,900.3	2,903.5	2,906.8	2,910.1	2,913.4	2,916.7
890	2,919.9	2,923.2	2,926.5	2,929.8	2,933.1	2,936.3	2,939.6	2,942.9	2,946.2	2,949.5

LENGTHS — METERS TO FEET (Continued)

	0	1	2	3	4	5	6	7	8	9
900	2,952.8	2,956.0	2,959.3	2,962.6	2,965.9	2,969.2	2,972.4	2,975.7	2,979.0	2,982.3
910	2,985.6	2,988.8	2,992.1	2,995.4	2,998.7	3,002.0	3,005.2	3,008.5	3,011.8	3,015.1
920	3,018.4	3,021.6	3,024.9	3,028.2	3,031.5	3,034.8	3,038.1	3,041.3	3,044.6	3,047.9
930	3,051.2	3,054.5	3,057.7	3,061.0	3,064.3	3,067.6	3,070.9	3,074.1	3,077.4	3,080.7
940	3,084.0	3,087.3	3,090.5	3,093.8	3,097.1	3,100.4	3,103,7	3,106.9	3,110.2	3,113.5
950	3,116.8	3,120.1	3,123.4	3,126.6	3,129.9	3,133.2	3,136.5	3,139.8	3,143.0	3,146.3
960	3,149.6	3,152.9	3,156.2	3,159.4	3,162.7	3,166.0	3,169.3	3,172.6	3,175.8	3,179.1
970	3,182.4	3,185.7	3,189.0	3,192.3	3,195.5	3,198.8	3,202.1	3,205.4	3,208.7	3,211.9
980	3,215.2	3,218.5	3,221.8	3,225.1	3,228.3	3,231.6	3,234.9	3,238.2	3,241.5	3,244.7
990	3,248.0	3,251.3	3,254.6	3,257.9	3,261.1	3,264.4	3,267.7	3,271.0	3,274.3	3,277.6

LENGTHS — FEET TO METERS

From 1 *to* 1,000 *Units*

Reduction factor: 1 foot = 0.3048006096 meter

The values found in the body of the table give, in meters, the lengths indicated in feet at the top and side.

	0	1	2	3	4	5	6	7	8	9
0	.....	0.30480	0.60960	0.91440	1.2192	1.5240	1.8288	2.1336	2.4384	2.7432
10	3.0480	3.3528	3.6576	3.9624	4.2672	4.5720	4.8768	5.1816	5.4864	5.7912
20	6.0960	6.4008	6.7056	7.0104	7.3152	7.6200	7.9248	8.2296	8.5344	8.8392
30	9.1440	9.4488	9.7536	10.058	10.363	10.668	10.973	11.278	11.582	11.887
40	12.192	12.497	12.802	13.106	13.411	13.716	14.021	14.326	14.630	14.935
50	15.240	15.545	15.850	16.154	16.459	16.764	17.069	17.374	17.678	17.983
60	18.288	18.593	18.898	19.202	19.507	19.812	20.117	20.422	20.726	21.031
70	21.336	21.641	21.946	22.250	22.555	22.860	23.165	23.470	23.774	24.079
80	24.384	24.689	24.994	24.298	25.603	25.908	26.213	26.518	26.822	27.127
90	27.432	27.737	28.042	28.346	28.651	28.956	29.261	29.566	29.870	30.175

LENGTHS — FEET TO METERS (Continued)

	0	1	2	3	4	5	6	7	8	9
100	30.480	30.785	31.090	31.394	31.699	32.004	32.309	32.614	32.918	33.223
110	33.528	33.833	34.138	34.442	34.747	35.052	35.357	35.662	35.966	36.271
120	36.576	36.881	37.186	37.490	37.795	38.100	38.405	38.710	39.014	39.319
130	39.624	39.929	40.234	40.538	40.843	41.148	41.453	41.758	42.062	42.367
140	42.672	42.977	43.282	43.586	43.891	44.196	44.501	44.806	45.110	45.415
150	45.720	46.025	46.330	46.635	46.939	47.244	47.549	47.854	48.159	48.463
160	48.768	49.073	49.378	49.683	49.987	50.292	50.597	50.902	51.207	51.511
170	51.816	52.121	52.426	52.731	53.035	53.340	53.645	53.950	54.255	54.559
180	54.864	55.169	55.474	55.779	56.083	56.388	56.693	56.998	57.303	57.607
190	57.912	58.217	58.522	58.827	59.131	59.436	59.741	60.046	60.351	60.655
200	60.960	61.265	61.570	61.875	62.179	62.484	62.789	63.094	63.399	63.703
210	64.008	64.313	64.618	64.923	65.227	65.532	65.837	66.142	66.447	66.751
220	67.056	67.361	67.666	67.971	68.275	68.580	68.885	69.190	69.495	69.799
230	70.104	70.409	70.714	71.019	71.323	71.628	71.933	72.238	72.543	72.847
240	73.152	73.457	73.762	74.067	74.371	74.676	74.981	75.286	75.591	75.895
250	76.200	76.505	76.810	77.115	77.419	77.724	78.029	78.334	78.639	78.943
260	79.248	79.553	79.858	80.162	80.467	80.772	81.077	81.382	81.687	81.991
270	82.296	82.601	82.906	83.211	83.515	83.820	84.125	84.430	84.735	85.039
280	85.344	85.649	85.954	86.259	86.563	86.868	87.173	87.478	87.783	88.087
290	88.392	88.697	89.002	89.307	89.611	89.916	90.221	90.526	90.831	91.135

LENGTHS — FEET TO METERS (Continued)

	0	1	2	3	4	5	6	7	8	9
300	91.440	91.745	92.050	92.355	92.659	92.964	93.269	93.574	93.879	94.183
310	94.488	94.793	95.098	95.403	95.707	96.012	96.317	96.622	96.927	97.231
320	97.536	97.841	98.146	98.451	98.755	99.060	99.365	99.670	99.975	100.28
330	100.58	100.89	101.19	101.50	101.80	102.11	102.41	102.72	103.02	103.33
340	103.63	103.94	104.24	104.55	104.85	105.16	105.46	105.77	106.07	106.38
350	106.68	106.99	107.29	107.59	107.90	108.20	108.51	108.81	109.12	109.42
360	109.73	110.03	110.34	110.64	110.95	111.25	111.56	111.86	112.17	112.47
370	112.78	113.08	113.39	113.69	114.00	114.30	114.61	114.91	115.21	115.52
380	115.82	116.13	116.43	116.74	117.04	117.35	117.65	117.96	118.26	118.57
390	118.87	119.18	119.48	119.79	120.09	120.40	120.70	121.01	121.31	121.62
400	121.92	122.23	122.53	122.83	123.14	123.44	123.75	124.05	124.36	124.66
410	124.97	125.27	125.58	125.88	126.19	126.49	126.80	127.10	127.41	127.71
420	128.02	128.32	128.63	128.93	129.24	129.54	129.85	130.15	130.45	130.76
430	131.06	131.37	131.67	131.98	132.28	132.59	132.89	133.20	133.50	133.81
440	134.11	134.42	134.72	135.03	135.33	135.64	135.94	136.25	136.55	136.86
450	137.16	137.47	137.77	138.07	138.38	138.68	138.99	139.29	139.60	139.90
460	140.21	140.51	140.82	141.12	141.43	141.73	142.04	142.34	142.65	142.95
470	143.26	143.56	143.87	144.17	144.48	144.78	145.09	145.39	145.69	146.00
480	146.30	146.61	146.91	147.22	147.52	147.83	148.13	148.44	148.74	149.05
490	149.35	149.66	149.96	150.27	150.57	150.88	151.18	151.49	151.79	152.10

LENGTHS — FEET TO METERS (Continued)

	0	1	2	3	4	5	6	7	8	9
500	152.40	152.71	153.01	153.31	153.62	153.92	154.23	154.53	154.84	155.14
510	155.45	155.75	156.06	156.36	156.57	156.97	157.28	157.58	157.89	158.19
520	158.50	158.80	159.11	159.41	159.72	160.02	160.33	160.63	160.93	161.24
530	161.54	161.85	162.15	162.46	162.76	163.07	163.37	163.68	163.98	164.29
540	164.59	164.90	165.20	165.51	165.81	166.12	166.42	166.73	167.03	167.34
550	167.64	167.95	168.25	168.55	168.86	169.16	169.47	169.77	170.08	170.38
560	170.69	170.99	171.30	171.60	171.91	172.21	172.52	172.82	173.13	173.43
570	173.74	174.04	174.35	174.65	174.96	175.26	175.57	175.87	176.17	176.48
580	176.78	177.09	177.39	177.70	178.00	178.31	178.61	178.92	179.22	179.53
590	179.83	180.14	180.44	180.75	181.05	181.36	181.66	181.97	182.27	182.58
600	182.88	183.19	183.49	183.79	184.10	184.40	184.71	185.01	185.32	185.62
610	185.93	186.23	186.54	186.84	187.15	187.45	187.76	188.06	188.37	188.67
620	188.98	189.28	189.59	189.89	190.20	190.50	190.81	191.11	191.41	191.72
630	192.02	192.33	192.63	192.94	193.24	193.55	193.85	194.16	194.46	194.77
640	195.07	195.38	195.68	195.99	196.29	196.60	196.90	197.21	197.51	197.82
650	198.12	198.43	198.73	199.03	199.34	199.64	199.95	200.25	200.56	200.86
660	201.17	201.47	201.78	202.08	202.39	202.69	203.00	203.30	203.61	203.91
670	204.22	204.52	204.83	205.13	205.44	205.74	206.05	206.35	206.65	206.96
680	207.26	207.57	207.87	208.18	208.48	208.79	209.09	209.40	209.70	210.01
690	210.31	210.62	210.92	211.23	211.53	211.84	212.14	212.45	212.75	213.06

LENGTHS — FEET TO METERS (Continued)

	0	1	2	3	4	5	6	7	8	9
700	213.36	213.67	213.97	214.27	214.58	214.88	215.19	215.49	215.80	216.10
710	216.41	216.71	217.02	217.32	217.63	217.93	218.24	218.54	218.85	219.15
720	219.46	219.76	220.07	220.37	220.68	220.98	221.29	221.59	221.89	222.20
730	222.50	222.81	223.11	223.42	223.72	224.03	224.33	224.64	224.94	225.25
740	225.55	225.86	226.16	226.47	226.77	227.08	227.38	227.69	227.99	228.30
750	228.60	228.91	229.21	229.51	229.82	230.12	230.43	230.73	231.04	231.34
760	231.65	231.95	232.26	232.56	232.87	233.17	233.48	233.78	234.09	234.39
770	234.70	235.00	235.31	235.61	235.92	236.22	236.53	236.83	237.13	237.44
780	237.74	238.05	238.35	238.66	238.96	239.27	239.57	239.88	240.18	240.49
790	240.79	241.10	241.40	241.71	242.01	242.32	242.62	242.93	243.23	243.54
800	243.84	244.15	244.45	244.75	245.06	245.36	245.67	245.97	246.28	246.58
810	246.89	247.19	247.50	247.80	248.11	248.41	248.72	249.02	249.33	249.63
820	249.94	250.24	250.55	250.85	251.16	251.46	251.77	252.07	252.37	252.68
830	252.98	253.29	253.59	253.90	254.20	254.51	254.81	255.12	255.42	255.73
840	256.03	256.34	256.64	256.95	257.25	257.56	257.86	258.17	258.47	258.78
850	259.08	259.39	259.69	259.99	260.30	260.60	260.91	261.21	261.52	261.82
860	262.13	262.43	262.74	263.04	263.35	263.65	263.96	264.26	264.57	264.87
870	265.18	265.48	265.79	266.09	266.40	266.70	267.01	267.31	267.61	267.92
880	268.22	268.53	268.83	269.14	269.44	269.75	270.05	270.36	270.66	270.97
890	271.27	271.58	271.88	272.19	272.49	272.80	273.10	273.41	273.71	274.02

LENGTHS—FEET TO METERS (Continued)

	0	1	2	3	4	5	6	7	8	9
900	274.32	274.63	274.93	275.23	275.54	275.84	276.15	276.45	276.76	277.06
910	277.37	277.67	277.98	278.28	278.59	278.89	279.20	279.50	279.81	280.11
920	280.42	280.72	281.03	281.33	281.64	281.94	282.25	282.55	282.85	283.16
930	283.46	283.77	284.07	284.38	284.68	284.99	285.29	285.60	285.90	286.21
940	286.51	286.82	287.12	287.43	287.73	288.04	288.34	288.65	288.95	289.26
950	289.56	289.87	289.17	290.47	290.78	291.08	291.39	291.69	292.00	292.30
960	292.61	292.91	293.22	293.52	293.83	294.13	294.44	294.74	295.05	295.35
970	295.66	295.96	296.27	296.57	296.88	297.18	297.49	297.79	298.10	298.40
980	298.70	299.01	299.31	299.62	299.92	300.23	300.53	300.84	301.14	301.45
990	301.75	302.06	302.36	302.67	302.97	303.28	303.58	303.89	304.19	304.50

LENGTHS — KILOMETERS TO MILES

From 1 *to* 1,000 *Units*

Reduction factor: 1 kilometer = 0.6213699495 mile

Values found in the body of the table give, in miles, the length indicated in kilometers at the top and side.

	0	1	2	3	4	5	6	7	8	9
0	.....	0.62137	1.2427	1.8641	2.4855	3.1069	3.7282	4.3496	4.9710	5.5923
10	6.2137	6.8351	7.4564	8.0778	8.6992	9.3206	9.9419	10.563	11.185	11.806
20	12.427	13.049	13.670	14.292	14.913	15.534	16.156	16.777	17.398	18.020
30	18.641	19.262	19.884	20.505	21.127	21.748	22.369	22.991	23.612	24.233
40	24.855	25.476	26.098	26.719	27.340	27.962	28.583	29.204	29.826	30.447
50	31.069	31.690	32.311	32.933	33.554	34.175	34.797	35.418	36.039	36.661
60	37.282	37.904	38.525	39.146	39.768	40.389	41.010	41.632	42.253	42.875
70	43.496	44.117	44.739	45.360	45.981	46.603	47.224	47.845	48.467	49.088
80	49.710	50.331	50.952	51.574	52.195	52.816	53.438	54.059	54.681	55.302
90	55.923	56.945	57.166	57.787	58.409	59.030	59.652	60.273	60.894	61.516

LENGTHS — KILOMETERS TO MILES (Continued)

	0	1	2	3	4	5	6	7	8	9
100	62.137	62.758	63.380	64.001	64.622	65.244	65.865	66.487	67.108	67.729
110	68.351	68.972	69.593	70.215	70.836	71.458	72.079	72.700	73.322	73.943
120	74.564	75.186	75.807	76.429	77.050	77.671	78.293	78.914	79.535	80.157
130	80.778	81.399	82.021	82.642	83.264	83.885	84.506	85.128	85.749	86.370
140	86.992	87.613	88.235	88.856	89.477	90.099	90.720	91.341	91.963	92.584
150	93.205	93.827	94.448	95.070	95.691	96.312	96.934	97.555	98.176	98.798
160	99.419	100.04	100.66	101.28	101.90	102.53	103.15	103.77	104.39	105.01
170	105.63	106.25	106.88	107.50	108.12	108.74	109.36	109.98	110.60	111.23
180	111.85	112.47	113.09	113.71	114.33	114.95	115.57	116.20	116.82	117.44
190	118.06	118.68	119.30	119.92	120.55	121.17	121.79	122.41	123.03	123.65
200	124.27	124.90	125.52	126.14	126.76	127.38	128.00	128.62	129.24	129.87
210	130.49	131.11	131.73	132.35	132.97	133.59	134.22	134.84	135.46	136.08
220	136.70	137.32	137.94	138.57	139.19	139.81	140.43	141.05	141.67	142.29
230	142.92	143.54	144.16	144.78	145.40	146.02	146.64	147.26	147.89	148.51
240	149.13	149.75	150.37	150.99	151.61	152.24	152.86	153.48	154.10	154.72
250	155.34	155.96	156.59	157.21	157.83	158.45	159.07	159.69	160.31	160.93
260	161.56	162.18	162.80	163.42	164.04	164.66	165.28	165.91	166.53	167.15
270	167.77	168.39	169.01	169.63	170.26	170.88	171.50	172.12	172.74	173.36
280	173.98	174.60	175.23	175.85	176.47	177.09	177.71	178.33	178.95	179.58
290	180.20	180.82	181.44	182.06	182.68	183.30	183.93	184.55	185.17	185.79

LENGTHS — KILOMETERS TO MILES (Continued)

	0	1	2	3	4	5	6	7	8	9
300	186.41	187.03	187.65	188.28	188.90	189.52	190.14	190.76	191.38	192.00
310	192.62	193.25	193.87	194.49	195.11	195.73	196.35	196.97	197.60	198.22
320	198.84	199.46	200.08	200.70	201.32	201.95	202.57	203.19	203.81	204.43
330	205.05	205.67	206.29	206.92	207.54	208.16	208.78	209.40	210.02	210.64
340	211.27	211.89	212.51	213.13	213.75	214.37	214.99	215.62	216.24	216.86
350	217.48	218.10	218.72	219.34	219.96	220.59	221.21	221.83	222.45	223.07
360	223.69	224.31	224.94	225.56	226.18	226.80	227.42	228.04	228.66	229.29
370	229.91	230.53	231.15	231.77	232.39	233.01	233.64	234.26	234.88	235.50
380	236.12	236.74	237.36	237.98	238.61	239.23	239.85	240.47	241.09	241.71
390	242.33	242.96	243.58	244.20	244.82	245.44	246.06	246.68	247.31	247.93
400	248.55	249.17	249.79	250.41	251.03	251.65	252.28	252.90	253.52	254.14
410	254.76	255.38	256.00	256.63	257.25	257.87	258.49	259.11	259.73	260.35
420	260.98	261.60	262.22	262.84	263.46	264.08	264.70	265.32	265.95	266.57
430	267.19	267.81	268.43	269.05	269.67	270.30	270.92	271.54	272.16	272.78
440	273.40	274.02	274.65	275.27	275.89	276.51	277.13	277.75	278.37	279.00
450	279.62	280.24	280.86	281.48	282.10	282.72	283.34	283.97	284.59	285.21
460	285.83	286.45	287.07	287.69	288.32	288.94	289.56	290.18	290.80	291.42
470	292.04	292.67	293.29	293.91	294.53	295.15	295.77	296.39	297.01	297.64
480	298.26	298.88	299.50	300.12	300.74	301.36	301.99	302.61	303.23	303.85
490	304.47	305.09	305.71	306.34	306.96	307.58	308.20	308.82	309.44	310.06

LENGTHS—KILOMETERS TO MILES (Continued)

	0	1	2	3	4	5	6	7	8	9
500	310.68	311.31	311.93	312.55	313.17	313.79	314.41	315.03	315.66	316.28
510	316.90	317.52	318.14	318.76	319.38	320.01	320.63	321.25	321.87	322.49
520	323.11	323.73	324.36	324.98	325.60	326.22	326.84	327.46	328.08	328.70
530	329.33	329.95	330.57	331.19	331.81	332.43	333.05	333.68	334.30	334.92
540	335.54	336.16	336.78	337.40	338.03	338.65	339.27	339.89	340.51	341.13
550	341.75	342.37	343.00	343.62	344.24	344.86	345.48	346.10	346.72	347.35
560	347.97	348.59	349.21	349.83	350.45	351.07	351.70	352.32	352.94	353.56
570	354.18	354.80	355.42	356.05	356.67	357.29	357.91	358.53	359.15	359.77
580	360.39	361.02	361.64	362.26	262.88	363.50	364.12	364.74	365.37	365.99
590	366.61	367.23	367.85	368.47	369.09	369.72	370.34	370.96	371.58	372.20
600	372.82	373.44	374.06	374.69	375.31	375.93	376.55	377.17	377.79	378.41
610	379.04	379.66	380.28	380.90	381.52	382.14	382.76	383.39	384.01	384.63
620	385.25	385.87	386.49	387.11	387.73	388.36	388.98	389.60	390.22	390.84
630	391.46	392.08	392.71	393.33	393.95	394.57	395.19	395.81	396.43	397.06
640	397.68	398.30	398.92	399.54	400.16	400.78	401.40	402.03	402.65	403.27
650	403.89	404.51	405.13	405.75	406.38	407.00	407.62	408.24	408.86	409.48
660	410.10	410.73	411.35	411.97	412.59	413.21	413.83	414.45	415.08	415.70
670	416.32	416.94	417.56	418.18	418.80	419.42	420.05	420.67	421.29	421.91
680	422.53	423.15	423.77	424.40	425.02	425.64	426.26	426.88	427.50	428.12
690	428.75	429.37	429.99	430.61	431.23	431.85	432.47	433.09	433.72	434.34

LENGTHS — KILOMETERS TO MILES (Continued)

	0	1	2	3	4	5	6	7	8	9
700	434.96	435.58	436.20	436.82	437.44	438.07	438.69	439.31	439.93	440.55
710	441.17	441.79	442.42	443.04	443.66	444.28	444.90	445.52	446.14	446.76
720	447.39	448.01	448.63	449.25	449.87	450.49	451.11	451.74	452.36	452.98
730	453.60	454.22	454.84	455.46	456.09	456.71	457.33	457.95	458.57	459.19
740	459.81	460.44	461.06	461.68	462.30	462.92	463.54	464.16	464.78	465.41
750	466.03	466.65	467.27	467.89	468.51	469.13	469.76	470.38	471.00	471.62
760	472.24	472.86	473.48	474.11	474.73	475.35	475.97	476.59	477.21	477.83
770	478.45	479.08	479.70	480.32	480.94	481.56	482.18	482.80	483.43	484.05
780	484.67	485.29	485.91	486.53	487.15	487.78	488.40	489.02	489.64	490.26
790	490.88	491.50	492.13	492.75	493.37	493.99	494.61	495.23	495.85	496.47
800	497.10	497.72	498.34	498.96	499.58	500.20	500.82	501.45	502.07	502.69
810	503.31	503.93	504.55	505.17	505.80	506.42	507.04	507.66	508.28	508.90
820	509.52	510.14	510.77	511.39	512.01	512.63	513.25	513.87	514.49	515.12
830	515.74	516.36	516.98	517.60	518.22	518.84	519.47	520.09	520.71	521.33
840	521.95	522.57	523.19	523.81	524.44	525.06	525.68	526.30	526.92	527.54
850	528.16	528.79	529.41	530.03	530.65	531.27	531.89	532.51	533.14	533.76
860	534.38	535.00	535.62	536.24	536.86	537.49	538.11	538.73	539.35	539.97
870	540.59	541.21	541.83	542.46	543.08	543.70	544.32	544.94	545.56	546.18
880	546.81	547.43	548.05	548.67	549.29	549.91	550.53	551.16	551.78	552.40
890	553.02	553.64	554.26	554.88	555.50	556.13	556.75	557.37	557.99	558.61

LENGTHS—KILOMETERS TO MILES (Continued)

	0	1	2	3	4	5	6	7	8	9
900	559.23	559.85	560.48	561.10	561.72	562.34	562.96	563.58	564.20	564.83
910	565.45	566.07	566.69	567.31	567.93	568.55	569.17	569.80	570.42	571.04
920	571.66	572.28	572.90	573.52	574.15	574.77	575.39	576.01	576.63	577.25
930	577.87	578.50	579.12	579.74	580.35	580.98	581.60	582.22	582.85	583.47
940	584.09	584.71	585.33	585.95	586.57	587.19	587.82	588.44	589.06	589.68
950	590.30	590.92	591.54	592.17	592.79	593.41	594.03	594.65	595.27	595.89
960	596.52	597.14	597.76	598.38	599.00	599.62	600.24	600.86	601.49	602.11
970	602.73	603.35	603.97	604.59	605.21	605.84	606.46	607.08	607.70	608.32
980	608.94	609.56	610.19	610.81	611.43	612.05	612.67	613.29	613.91	614.53
990	615.16	615.78	616.40	617.02	617.64	618.26	618.88	619.51	620.13	620.75

LENGTHS — MILES TO KILOMETERS

From 1 *to* 1,000 *Units*

Reduction factor: 1 mile = 1.609347219 kilometers

Values found in the body of the table give, in kilometers, the length indicated in miles at the top and side.

	0	1	2	3	4	5	6	7	8	9
0	.....	1.6093	3.2187	4.8280	6.4374	8.0467	9.6561	11.265	12.875	14.484
10	16.093	17.703	19.312	20.922	22.531	24.140	25.750	27.359	28 968	30.578
20	32.187	33.796	35.406	37.015	38.624	40.234	41.843	43.452	45.062	46.671
30	48.280	49.890	51.499	53.108	54.718	56.327	57.936	59.546	61.155	62.765
40	64.374	65.983	67.593	69.202	70.811	72.421	74.030	75.639	77.249	78.858
50	80.467	82.077	83.686	85.295	86.905	88.514	90.123	91.733	93.342	94.951
60	96.561	98.170	99.780	101.39	103.00	104.61	106.22	107.83	109.44	111.04
70	112.65	114.26	115.87	117.48	119.09	120.70	122.31	123.92	125.53	127.14
80	128.75	130.36	131.97	133.58	135.19	136.79	138.40	140.01	141.62	143.23
90	144.84	146.45	148.06	149.67	151.28	152.89	154.50	156.11	157.72	159.33

LENGTHS — MILES TO KILOMETERS (Continued)

	0	1	2	3	4	5	6	7	8	9
100	160.93	162.54	164.15	165.76	167.37	168.98	170.59	172.20	173.81	175.42
110	177.03	178.64	180.25	181.86	183.47	185.07	186.68	188.29	189.90	191.51
120	193.12	194.73	196.34	197.95	199.56	201.17	202.78	204.39	206.00	207.61
130	209.22	210.82	212.43	214.04	215.65	217.26	218.87	220.48	222.09	223.70
140	225.31	226.92	228.53	230.14	231.75	233.36	234.96	236.57	238.18	239.79
150	241.40	243.01	244.62	246.23	247.84	249.45	251.06	252.67	254.28	255.89
160	257.50	259.10	260.71	262.32	263.93	265.54	267.15	268.76	270.37	271.98
170	273.59	275.20	276.81	278.42	280.03	281.64	283.25	284.85	286.46	288.07
180	289.68	291.29	292.90	294.51	296.12	297.73	299.34	300.95	302.56	304.17
190	305.78	307.39	308.99	310.60	312.21	313.82	315.43	317.04	318.65	320.26
200	321.87	323.48	325.09	326.70	328.31	329.92	331.53	333.13	334.74	336.35
210	337.96	339.57	341.18	342.79	344.40	346.01	347.62	349.23	350.84	352.45
220	354.06	355.67	357.28	358.88	360.49	362.10	363.71	365.32	366.93	368.54
230	370.15	371.76	373.37	374.98	376.59	378.20	379.81	381.42	383.02	384.63
240	386.24	387.85	389.46	391.07	392.68	394.29	395.90	397.51	399.12	300.73
250	402.34	403.95	405.56	407.16	408.77	410.38	411.99	413.60	415.21	416.82
260	418.43	420.04	421.65	423.26	424.87	426.48	428.09	429.70	431.30	432.91
270	434.52	436.13	437.74	439.35	440.96	442.57	444.18	445.79	447.40	449.01
280	450.62	452.23	453.84	455.45	457.05	458.66	460.27	461.88	463.49	465.10
290	466.71	468.32	469.93	471.54	473.15	474.76	476.37	477.98	479.59	481.19

LENGTHS — MILES TO KILOMETERS (Continued)

	0	1	2	3	4	5	6	7	8	9
300	482.80	484.41	486.02	487.63	489.24	490.85	492.46	494.07	495.68	497.29
310	498.90	500.51	502.12	503.73	505.34	506.94	508.55	510.16	511.77	513.38
320	514.99	516.60	518.21	519.82	521.43	523.04	524.65	526.26	527.87	529.48
330	531.08	532.69	534.30	535.91	537.52	539.13	540.74	542.35	543.96	545.57
340	547.18	548.79	550.40	552.01	553.62	555.22	556.83	558.44	560.05	561.66
350	563.27	564.88	566.49	568.10	569.71	571.32	572.93	574.54	576.15	577.76
360	579.36	580.97	582.58	584.19	585.80	587.41	589.02	590.63	592.24	593.85
370	595.46	597.07	598.68	600.29	601.90	603.51	605.11	606.72	608.33	609.94
380	611.55	613.16	614.77	616.38	317.99	619.60	621.21	622.82	624.43	626.04
390	627.65	629.25	630.86	632.47	634.08	635.69	637.30	638.91	640.52	642.13
400	643.74	645.35	646.96	648.57	650.18	651.79	653.40	655.00	656.61	658.22
410	659.83	661.44	663.05	664.66	666.27	667.88	669.49	671.10	672.71	674.32
420	675.93	677.54	679.14	680.75	682.36	683.97	685.58	687.19	688.80	690.41
430	692.02	693.63	695.24	696.85	698.46	700.07	701.68	703.28	704.89	706.50
440	708.11	709.72	711.33	712.94	714.55	716.16	717.77	719.38	720.99	722.60
450	724.21	725.82	727.42	729.03	730.64	732.25	733.86	735.47	737.08	738.69
460	740.30	741.91	743.52	745.13	746.74	748.35	749.96	751.57	753.17	754.78
470	756.39	758.00	759.61	761.22	762.83	764.44	766.05	767.66	769.27	770.88
480	772.49	774.10	775.71	777.31	778.92	780.53	782.14	783.75	785.36	786.97
490	788.58	790.19	791.80	793.41	795.02	796.63	798.24	799.85	801.45	803.06

LENGTHS — MILES TO KILOMETERS (Continued)

	0	1	2	3	4	5	6	7	8	9
500	804.67	806.28	807.89	809.50	811.11	812.72	814.33	815.94	817.55	819.16
510	820.77	822.38	823.99	825.60	827.20	828.81	830.42	832.03	833.64	835.25
520	836.86	838.47	840.08	841.69	843.30	844.91	846.52	848.13	849.74	851.34
530	852.95	854.56	856.17	857.78	859.39	861.00	862.61	864.22	865.83	867.44
540	869.05	870.66	872.27	873.88	875.48	877.09	878.70	880.31	881.92	883.53
550	885.14	886.75	888.36	889.97	891.58	893.19	894.80	896.41	898.02	899.62
560	901.23	902.84	904.45	906.06	907.67	909.28	910.89	912.50	914.11	915.72
570	917.33	918.94	920.55	922.16	923.77	925.37	926.98	928.59	930.20	931.81
580	933.42	935.03	936.64	938.25	939.86	941.47	943.08	944.69	946.30	947.91
590	949.51	951.12	952.73	954.34	955.95	957.56	959.17	960.78	962.39	964.00
600	965.61	967.22	968.83	970.44	972.05	973.65	975.26	976.87	978.48	980.09
610	981.70	983.31	984.92	986.53	988.14	989.75	991.36	992.97	994.58	996.19
620	997.80	999.40	1,001.0	1,002.6	1,004.2	1,005.8	1,007.5	1,009.1	1,010.7	1,012.3
630	1,013.9	1,015.5	1,017.1	1,018.7	1,020.3	1,021.9	1,023.5	1,025.2	1,026.8	1,028.4
640	1,030.0	1,031.6	1,033.2	1,034.8	1,036.4	1,038.0	1,039.6	1,041.2	1,042.9	1,044.5
650	1,046.1	1,047.7	1,049.3	1,050.9	1,052.5	1,054.1	1,055.7	1,057.3	1,059.0	1,060.6
660	1,062.2	1,063.8	1,065.4	1,067.0	1,068.6	1,070.2	1,071.8	1,073.4	1,075.0	1,076.7
670	1,078.3	1,079.9	1,081.5	1,083.1	1,084.7	1,086.3	1,087.9	1,089.5	1,091.1	1,092.7
680	1,094.4	1,096.0	1,097.6	1,099.2	1,100.8	1,102.4	1,104.0	1,105.6	1,107.2	1,108.8
690	1,110.4	1,112.1	1,113.7	1,115.3	1,116.9	1,118.5	1,120.1	1,121.7	1,123.3	1,124.9

LENGTHS — MILES TO KILOMETERS (Continued)

	0	1	2	3	4	5	6	7	8	9
700	1,126.5	1,128.2	1,129.8	1,131.4	1,133.0	1,134.6	1,136.2	1,137.8	1,139.4	1,141.0
710	1,142.6	1,144.2	1,145.9	1,147.5	1,149.1	1,150.7	1,152.3	1,153.9	1,155.5	1,157.1
720	1,158.7	1,160.3	1,161.9	1,163.6	1,165.2	1,166.8	1,168.4	1,170.0	1,171.6	1,173.2
730	1,174.8	1,176.4	1,178.0	1,179.7	1,181.3	1,182.9	1,184.5	1,186.1	1,187.7	1,189.3
740	1,190.9	1,192.5	1,194.1	1,195.7	1,197.4	1,199.0	1,200.6	1,202.2	1,203.8	1,205.4
750	1,207.0	1,208.6	1,210.2	1,211.8	1,213.4	1,215.1	1,216.7	1,218.3	1,219.9	1,221.5
760	1,223.1	1,224.7	1,226.3	1,227.9	1,229.5	1,231.2	1,232.8	1,234.4	1,236.0	1,237.6
770	1,239.2	1,240.8	1,242.4	1,244.0	1,245.6	1,247.2	1,248.9	1,250.5	1,252.1	1,253.7
780	1,255.3	1,256.9	1,258.5	1,260.1	1,261.7	1,263.3	1,264.9	1,266.6	1,268.2	1,269.8
790	1,271.4	1,273.0	1,274.6	1,276.2	1,277.8	1,279.4	1,281.0	1,282.6	1,284.3	1,285.9
800	1,287.5	1,289.1	1,290.7	1,292.3	1,293.9	1,295.5	1,297.1	1,298.7	1,300.4	1,302.0
810	1,303.6	1,305.2	1,306.8	1,308.4	1,310.0	1,311.6	1,313.2	1,314.8	1,316.4	1,318.1
820	1,319.7	1,321.3	1,322.9	1,324.5	1,326.1	1,327.7	1,329.3	1,330.9	1,332.5	1,334.1
830	1,335.8	1,337.4	1,339.0	1,340.6	1,342.2	1,343.8	1,345.4	1,347.0	1,348.6	1,350.2
840	1,351.9	1,353.5	1,355.1	1,356.7	1,358.3	1,359.9	1,361.5	1,363.1	1,364.7	1,366.3
850	1,367.9	1,369.6	1,371.2	1,372.8	1,374.4	1,376.0	1,377.6	1,379.2	1,380.8	1,382.4
860	1,384.0	1,385.6	1,387.3	1,388.9	1,390.5	1,392.1	1,393.7	1,395.3	1,396.9	1,398.5
870	1,400.1	1,401.7	1,403.4	1,405.0	1,406.6	1,408.2	1,409.8	1,411.4	1,413.0	1,414.6
880	1,416.2	1,417.8	1,419.4	1,421.1	1,422.7	1,424.3	1,425.9	1,427.5	1,429.1	1,430.7
890	1,432.3	1,433.9	1,435.5	1,437.1	1,438.8	1,440.4	1,442.0	1,443.6	1,445.2	1,446.8

LENGTHS — MILES TO KILOMETERS (Continued)

	0	1	2	3	4	5	6	7	8	9
900	1,448.4	1,450.0	1,451.6	1,453.2	1,454.8	1,456.5	1,458.1	1,459.7	1,461.3	1,462.9
910	1,464.5	1,466.1	1,467.7	1,469.3	1,470.9	1,472.6	1,474.2	1,475.8	1,477.4	1,479.0
920	1,480.6	1,482.2	1,483.8	1,485.4	1,487.0	1,488.6	1,490.3	1,491.9	1,493.5	1,495.1
930	1,496.7	1,498.3	1,499.9	1,501.5	1,503.1	1,504.7	1,506.3	1,508.0	1,509.6	1,511.2
940	1,512.8	1,514.4	1,516.0	1,517.6	1,519.2	1,520.8	1,522.4	1,524.1	1,525.7	1,527.3
950	1,528.9	1,530.5	1,532.1	1,533.7	1,535.3	1,536.9	1,538.5	1,540.1	1,541.8	1,543.4
960	1,545.0	1,546.6	1,548.2	1,549.8	1,551.4	1,553.0	1,554.6	1,556.2	1,557.8	1,559.5
970	1,561.1	1,562.7	1,564.3	1,565.9	1,567.5	1,569.1	1,570.7	1,572.3	1,573.9	1,575.6
980	1,577.2	1,578.8	1,580.4	1,582.0	1,583.6	1,585.2	1,586.8	1,588.4	1,590.0	1,591.6
990	1,593.3	1,594.9	1,596.5	1,598.1	1,599.7	1,601.3	1,602.9	1,604.5	1,606.1	1,607.7

CAPACITIES — LITERS TO LIQUID QUARTS

From 1 *to* 1,000 *Units*

Reduction factor: 1 liter = 1.056681869 liquid quarts

The values found in the body of the table give, in liquid quarts, the capacities indicated in liters at the top and side.

	0	1	2	3	4	5	6	7	8	9
0	.....	1.0567	2.1134	3.1701	4.2267	5.2834	6.3401	7.3968	8.4535	9.5101
10	10.567	11.624	12.680	13.737	14.794	15.850	16.907	17.964	19.020	20.077
20	21.134	22.190	23.247	24.304	25.360	26.417	27.474	28.530	29.587	30.644
30	31.700	32.757	33.814	34.871	35.927	36.984	38.041	39.097	40.154	41.211
40	42.267	43.324	44.381	45.437	46.494	47.551	48.607	49.664	50.721	51.777
50	52.834	53.891	54.947	56.004	57.061	58.118	59.174	60.231	61.288	62.344
60	63.401	64.458	65.514	66.571	67.628	68.684	69.741	70.798	71.854	72.911
70	73.968	75.024	76.081	77.138	78.194	79.251	80.308	81.365	82.421	83.478
80	84.535	85.591	86.648	87.705	88.761	89.818	90.875	91.931	92.988	94.045
90	95.101	96.158	97.215	98.271	99.328	100.38	101.44	102.50	103.55	104.61

CAPACITIES — LITERS TO LIQUID QUARTS (Continued)

	0	1	2	3	4	5	6	7	8	9
100	105.67	106.72	107.78	108.84	109.89	110.95	112.01	113.06	114.12	115.18
110	116.24	117.29	118.35	119.41	120.46	121.52	122.58	123.63	124.69	125.75
120	126.80	127.86	128.92	129.97	131.03	132.09	133.14	134.20	135.26	136.31
130	137.37	138.43	139.48	140.54	141.60	142.65	143.71	144.77	145.82	146.88
140	147.94	148.99	150.05	151.11	152.16	153.22	154.28	155.33	156.39	157.45
150	158.50	159.56	160.62	161.67	162.73	163.79	164.84	165.90	166.96	168.01
160	169.07	170.13	171.18	172.24	173.30	174.35	175.41	176.47	177.52	178.58
170	179.64	180.69	181.75	182.81	183.86	184.92	185.98	187.03	188.09	189.15
180	190.20	191.26	192.32	193.37	194.43	195.49	196.54	197.60	198.66	199.71
190	200.77	201.83	202.88	203.94	205.00	206.05	207.11	208.17	209.22	210.28
200	211.34	212.39	213.45	214.51	215.56	216.62	217.68	218.73	219.79	220.85
210	221.90	222.96	224.02	225.07	226.13	227.19	228.24	229.30	230.36	231.41
220	232.47	233.53	234.58	235.64	236.70	237.75	238.81	239.87	240.92	241.98
230	243.04	244.09	245.15	246.21	247.26	248.32	249.38	250.43	251.49	252.55
240	253.60	254.66	255.72	256.77	257.83	258.89	259.94	261.00	262.06	263.11
250	264.17	265.23	266.28	267.34	268.40	269.45	270.51	271.57	272.62	273.68
260	274.74	275.79	276.85	277.91	278.96	280.02	281.08	282.13	283.19	284.25
270	285.30	286.36	287.42	288.47	289.53	290.59	291.64	292.70	293.76	294.81
280	295.87	296.93	297.98	299.04	300.10	301.15	302.21	303.27	304.32	305.38
290	306.44	307.49	308.55	309.61	310.66	311.72	312.78	313.83	314.89	315.95

CAPACITIES — LITERS TO LIQUID QUARTS (Continued)

	0	1	2	3	4	5	6	7	8	9
300	317.00	318.06	319.12	320.17	321.23	322.29	323.34	324.40	325.46	326.51
310	327.57	328.63	329.68	330.74	331.80	332.85	333.91	334.97	336.02	337.08
320	338.14	339.19	340.25	341.31	342.36	343.42	344.48	345.53	346.59	347.65
330	348.71	349.76	350.82	351.88	352.93	353.99	355.05	356.10	357.16	358.22
340	359.27	360.33	361.39	362.44	363.50	364.56	365.61	366.67	367.73	368.78
350	369.84	370.90	371.95	373.01	374.07	375.12	376.18	377.24	378.29	379.35
360	380.41	381.46	382.52	383.58	384.63	385.69	386.75	387.80	388.86	389.92
370	390.97	392.03	393.09	394.14	395.20	396.26	397.31	398.37	399.43	400.48
380	401.54	402.60	403.65	404.71	405.77	406.82	407.88	408.94	409.99	411.05
390	412.11	413.16	414.22	415.28	416.33	417.39	418.45	419.50	420.56	421.62
400	422.67	423.73	424.79	425.84	426.90	427.96	429.01	430.07	431.13	432.18
410	433.24	434.30	435.35	436.41	437.47	438.52	439.58	440.64	441.69	442.75
420	443.81	444.86	445.92	446.98	448.03	449.09	450.15	451.20	452.26	453.32
430	454.37	455.43	456.49	457.54	458.60	459.66	460.71	461.77	462.83	463.88
440	464.94	466.00	467.05	468.11	469.17	470.22	471.28	472.34	473.39	474.45
450	475.51	476.56	477.62	478.68	479.73	480.79	481.85	482.90	483.96	485.02
460	486.07	487.13	488.19	489.24	490.30	491.36	492.41	493.47	494.53	495.58
470	496.64	497.70	498.75	499.81	500.87	501.92	502.98	504.04	505.09	506.15
480	507.21	508.26	509.32	510.38	511.43	512.49	513.55	514.60	515.66	516.72
490	517.77	518.83	519.89	520.94	522.00	523.06	524.11	525.17	526.23	527.28

CAPACITIES — LITERS TO LIQUID QUARTS (Continued)

	0	1	2	3	4	5	6	7	8	9
500	528.34	529.40	530.45	531.51	532.57	533.62	534.68	535.74	536.79	537.85
510	538.91	539.96	541.02	542.08	543.13	544.19	545.25	546.30	547.36	548.42
520	549.47	550.53	551.59	552.64	553.70	554.76	555.81	556.87	557.93	558.98
530	560.04	561.10	562.15	563.21	564.27	565.32	566.38	567.44	568.49	569.55
540	570.61	571.66	572.72	573.78	574.83	575.89	576.95	578.00	579.06	580.12
550	581.18	582.23	583.29	584.35	585.40	586.46	587.52	588.57	589.63	590.69
560	591.74	592.80	593.86	594.91	595.97	597.03	598.08	599.14	600.20	601.25
570	602.31	603.37	604.42	605.48	606.54	607.59	608.65	609.71	610.76	611.82
580	612.88	613.93	614.99	616.05	617.10	618.16	619.22	620.27	621.33	622.39
590	623.44	624.50	625.56	626.61	627.67	628.73	629.78	630.84	631.90	632.95
600	634.01	635.07	636.12	637.18	638.24	639.29	640.35	641.41	642.46	643.52
610	644.58	645.63	646.69	647.75	648.80	649.86	650.92	651.97	653.03	654.09
620	655.14	656.20	657.26	658.31	659.37	660.43	661.48	662.54	663.60	664.65
630	665.71	666.77	667.82	668.88	669.94	670.99	672.05	673.11	674.16	675.22
640	676.28	677.33	678.39	679.45	680.50	681.56	682.62	683.67	684.73	685.79
650	686.84	687.90	688.96	690.01	691.07	692.13	693.18	694.24	695.30	696.35
660	697.41	698.47	699.52	700.58	701.64	702.69	703.75	704.81	705.86	706.92
670	707.98	709.03	710.09	711.15	712.20	713.26	714.32	715.37	716.43	717.49
680	718.54	719.60	720.66	721.71	722.77	723.83	724.88	725.94	727.00	728.05
690	729.11	730.17	731.22	732.28	733.34	734.39	735.45	736.51	737.56	738.62

CAPACITIES — LITERS TO LIQUID QUARTS (Continued)

	0	1	2	3	4	5	6	7	8	9
700	739.68	740.73	741.79	742.85	743.90	744.96	746.02	747.07	748.13	749.19
710	750.24	751.30	752.36	753.41	754.47	755.53	756.58	757.64	758.70	759.75
720	760.81	761.87	762.92	763.98	765.04	766.09	767.15	768.21	769.26	770.32
730	771.38	772.43	773.49	774.55	775.60	776.66	777.72	778.77	779.83	780.89
740	781.94	783.00	784.06	785.11	786.17	787.23	788.28	789.34	790.40	791.45
750	792.51	793.57	794.62	795.68	796.74	797.79	798.85	799.91	800.96	802.02
760	803.08	804.13	805.19	806.25	807.30	808.36	809.42	810.47	811.53	812.59
770	813.65	814.70	815.76	816.82	817.87	818.93	819.99	821.04	822.10	823.16
780	824.21	825.27	826.33	827.38	828.44	829.50	830.55	831.61	832.67	833.72
790	834.78	835.84	836.89	837.95	839.01	840.06	841.12	842.18	843.23	844.29
800	845.35	846.40	847.46	848.52	849.57	850.63	851.69	852.74	853.80	854.86
810	855.91	856.97	858.03	859.08	860.14	861.20	862.25	863.31	864.37	865.42
820	866.48	867.54	868.59	869.65	870.71	871.76	872.82	873.88	874.93	875.99
830	877.05	878.10	879.16	880.22	881.27	882.33	883.39	884.44	885.50	886.56
840	887.61	888.67	889.73	890.78	891.84	892.90	893.95	895.01	896.07	897.12
850	898.18	899.24	900.29	901.35	902.41	903.46	904.52	905.58	906.63	907.69
860	908.75	909.80	910.86	911.92	912.97	914.03	915.09	916.14	917.20	918.26
870	919.31	920.37	921.43	922.48	923.54	924.60	925.65	926.71	927.77	928.82
880	929.88	930.94	931.99	933.05	934.11	935.16	936.22	937.28	938.33	939.39
890	940.45	941.50	942.56	953.62	944.67	945.73	946.79	947.84	948.90	949.96

CAPACITIES — LITERS TO LIQUID QUARTS (Continued)

	0	1	2	3	4	5	6	7	8	9
900	951.01	952.07	953.13	954.18	955.24	956.30	957.35	958.41	959.47	960.52
910	961.58	962.64	963.69	964.75	965.81	966.86	967.92	968.98	970.03	971.09
920	972.15	973.20	974.26	975.32	976.37	977.43	978.49	979.54	980.60	981.66
930	982.71	983.77	984.83	985.88	986.94	988.00	989.05	990.11	991.17	992.22
940	993.28	994.34	995.39	996.45	997.51	998.56	999.62	1,000.7	1,001.7	1,002.8
950	1,003.8	1,004.9	1,006.0	1,007.0	1,008.1	1,009.1	1,010.2	1,011.2	1,012.3	1,013.4
960	1,014.4	1,015.5	1,016.5	1,017.6	1,018.6	1,019.7	1,020.8	1,021.8	1,022.9	1,023.9
970	1,025.0	1,026.0	1,027.1	1,028.2	1,029.2	1,030.3	1,031.3	1,032.4	1,033.4	1,034.5
980	1,035.5	1,036.6	1,037.7	1,038.7	1,039.8	1,040.8	1,041.9	1,042.9	1,044.0	1,045.1
990	1,046.1	1,047.2	1,048.2	1,049.3	1,050.3	1,051.4	1,052.5	1,053.5	1,054.6	1,055.6

CAPACITIES — LIQUID QUARTS TO LITERS

From 1 *to* 1,000 *Units*

Reduction factor; 1 liquid quart = 0.9463586241 liter

The values found in the body of the table give, in liters, the capacities indicated in liquid quarts at the top and side.

	0	1	2	3	4	5	6	7	8	9
0	.....	0.94636	1.8927	2.8391	3.7854	4.7318	5.6782	6.6245	7.5709	8.5172
10	9.4636	10.410	11.353	12.303	13.249	14.195	15.142	16.088	17.034	17.981
20	18.927	19.874	20.820	21.766	22.713	23.659	24.605	25.552	26.498	27.444
30	28.391	29.337	30.283	31.230	32.176	33.123	34.069	35.015	35.962	36.908
40	37.854	38.801	39.747	40.693	41.640	42.586	43.533	44.479	45.425	46.372
50	47.318	48.264	49.211	50.157	51.103	52.050	52.996	53 942	54.889	55.835
60	56.782	57.728	58.674	59.621	60.567	61.513	62.460	63.406	64.352	65.299
70	66.245	67.191	68.138	69.084	70.031	70.977	71.923	72.870	73.816	74.862
80	75.709	76.655	77.601	78.548	79.494	80.440	81.387	82.333	83.280	84.226
90	85.172	86.119	87.065	88.011	88.958	89.904	90.850	91.797	92.743	93.690

CAPACITIES — LIQUID QUARTS TO LITERS (Continued)

	0	1	2	3	4	5	6	7	8	9
100	94.636	95.582	96.529	97.475	98.421	99.368	100.31	101.26	102.21	103.15
110	104.10	105.05	105.99	106.94	107.88	108.83	109.78	110.72	111.67	112.62
120	113.56	114.51	115.46	116.40	117.35	118.29	119.24	120.19	121.13	122.08
130	123.03	123.97	124.92	125.87	126.81	127.76	128.70	129.65	130.60	131.54
140	132.49	133.44	134.38	135.33	136.28	137.22	138.17	139.11	140.06	141.01
150	141.95	142.90	143.85	144.79	145.74	146.69	147.63	148.58	149.52	150.47
160	151.42	152.36	153.31	154.26	155.20	156.15	157.10	158.04	158.99	159.93
170	160.88	161.83	162.77	163.72	164.67	165.61	166.56	167.51	168.45	169.40
180	170.34	171.29	172.24	173.18	174.13	175.08	176.02	176.97	177.92	178.86
190	179.81	180.75	181.70	182.65	183.59	184.54	185.49	186.43	187.38	188.33
200	189.27	190.22	191.16	192.11	193.06	194.00	194.95	195.90	196.84	197.79
210	198.74	199.68	200.63	201.57	202.52	203.47	204.41	205.36	206.31	207.25
220	208.20	209.15	210.09	211.04	211.98	212.93	213.88	214.82	215.77	216.72
230	217.66	218.61	219.56	220.50	221.45	222.39	223.34	224.29	225.23	226.18
240	227.13	228.07	229.02	229.97	230.91	231.86	232.80	233.75	234.70	235.64
250	236.59	237.54	238.48	239.43	240.38	241.32	242.27	243.21	244.16	245.11
260	246.05	247.00	247.95	248.89	249.84	250.79	251.73	252.68	253.62	254.57
270	255.52	256.46	257.41	258.36	259.30	260.25	261.19	262.14	263.09	264.03
280	264.98	265.93	266.87	267.82	268.77	269.71	270.66	271.60	272.55	273.50
290	274.44	275.39	276.34	277.28	278.23	279.18	280.12	281.07	282.01	282.96

CAPACITIES — LIQUID QUARTS TO LITERS (Continued)

	0	1	2	3	4	5	6	7	8	9
300	283.91	284.85	285.80	286.75	287.69	288.64	289.59	290.53	291.48	292.42
310	293.37	294.32	295.26	296.21	297.16	298.10	299.05	300.00	300.94	301.89
320	302.83	303.78	304.73	305.67	306.62	307.57	308.51	309.46	310.41	311.35
330	312.30	313.24	314.19	315.14	316.08	317.03	317.98	318.92	319.87	320.82
340	321.76	322.71	323.65	324.60	325.55	326.49	327.44	328.39	329.33	330.28
350	331.23	332.17	333.12	334.06	335.01	335.96	336.90	337.85	338.80	339.74
360	340.69	341.64	342.58	343.53	344.47	345.42	346.37	347.31	348.26	349.21
370	350.15	351.10	352.05	352.99	353.94	354.88	355.83	356.78	357.72	358.67
380	359.62	360.56	361.51	362.46	363.40	364.35	365.29	366.24	367.19	368.13
390	369.08	370.03	370.97	371.92	372.87	373.81	374.76	375.70	376.65	377.60
400	378.54	379.49	380.44	381.38	382.33	383.28	384.22	385.17	386.11	387.06
410	388.01	388.95	389.90	390.85	391.79	392.74	393.69	394.63	395.58	396.52
420	397.47	393.42	399.36	400.31	401.26	402.20	403.15	404.10	105.04	405.99
430	406.93	407.88	408.83	409.77	410.72	411.67	412.61	413.56	414.51	415.45
440	416.40	417.34	418.29	419.24	420.18	421.13	422.08	423.02	423.97	424.92
450	425.86	426.81	427.75	428.70	429.65	430.59	431.54	432.49	433.43	434.38
460	435.32	436.27	437.22	438.16	439.11	440.06	441.00	441.95	442.90	443.84
470	444.79	445.73	446.68	447.63	448.57	449.52	450.47	451.41	452.36	453.31
480	454.25	455.20	456.14	457.09	458.04	458.98	459.93	460.88	461.82	462.77
490	463.72	464.66	465.61	466.55	467.50	468.45	469.39	470.34	471.29	472.23

CAPACITIES — LIQUID QUARTS TO LITERS (Continued)

	0	1	2	3	4	5	6	7	8	9
500	473.18	474.13	475.07	476.02	476.96	477.91	478.86	479.80	480.75	481.70
510	482.64	483.59	484.54	485.48	486.43	487.37	488.32	489.27	490.21	491.16
520	492.11	493.05	494.00	494.95	495.89	496.84	497.78	498.73	499.68	500.62
530	501.57	502.52	503.46	504.41	505.36	506.30	507.25	508.19	509.14	510.09
540	511.03	511.98	512.93	513.87	514.82	515.77	516.71	517.66	518.60	519.55
550	520.50	521.44	522.39	523.34	524.28	525.23	526.18	527.12	528.07	529.01
560	529.96	530.91	531.85	532.80	533.75	534.69	535.64	536.59	537.53	538.48
570	539.42	540.37	541.32	542.26	543.21	544.16	545.10	546.05	547.00	547.94
580	548.89	549.83	550.78	551.73	552.67	553.62	554.57	555.51	556.46	557.41
590	558.35	559.30	560.24	561.19	562.14	563.08	564.03	564.98	565.92	566.87
600	567.82	568.76	569.71	570.65	571.60	572.55	573.49	574.44	575.39	576.33
610	577.28	578.23	579.17	580.12	581.06	582.01	582.96	583.90	584.85	585.80
620	586.74	587.69	588.64	589.58	590.53	591.47	592.42	593.37	594.31	595.26
630	596.21	597.15	598.10	599.05	599.99	600.94	601.88	602.83	603.78	604.72
640	605.67	606.62	607.56	608.51	609.45	610.40	611.35	612.29	613.24	614.19
650	615.13	616.08	617.03	617.97	618.92	619.86	620.81	621.76	622.70	623.65
660	624.60	625.54	626.49	627.44	628.38	629.33	630.27	631.22	632.17	633.11
670	634.06	635.01	635.95	636.90	637.85	638.79	639.74	640.68	641.63	642.58
680	643.52	644.47	645.42	646.36	647.31	648.26	649.20	650.15	651.09	652.04
690	652.99	653.93	654.88	655.83	656.77	657.72	658.67	659.61	660.56	661.50

CAPACITIES—LIQUID QUARTS TO LITERS (Continued)

	0	1	2	3	4	5	6	7	8	9
700	662.45	663.40	664.34	665.29	666.24	667.18	668.13	669.08	670.02	670.97
710	671.91	672.86	673.81	674.75	675.70	676.65	677.59	678.54	679.49	680.43
720	681.38	682.32	683.27	684.22	685.16	686.11	687.06	688.00	688.95	689.90
730	690.84	691.79	692.73	693.68	694.63	695.57	696.52	697.47	698.41	699.36
740	700.31	701.25	702.20	703.14	704.09	705.04	705.98	706.93	707.88	708.82
750	709.77	710.72	711.66	712.61	713.55	714.50	715.45	716.39	717.34	718.29
760	719.23	720.18	721.13	722.07	723.02	723.96	724.91	725.86	726.80	727.75
770	728.70	729.64	730.59	731.54	732.48	733.43	734.37	735.32	736.27	737.21
780	738.16	739.11	740.05	741.00	741.95	742.89	743.84	744.78	745.73	746.68
790	747.62	748.57	749.52	750.46	751.41	752.36	753.30	754.25	755.19	756.14
800	757.09	758.03	758.98	759.93	760.87	761.82	762.77	763.71	764.66	765.60
810	766.55	767.50	768.44	769.39	770.34	771.28	772.23	773.18	774.12	775.07
820	776.01	776.96	777.91	778.85	779.80	780.75	781.69	782.64	783.59	784.53
830	785.48	786.42	787.37	788.32	789.26	790.21	791.16	792.10	793.05	793.99
840	794.94	795.89	796.83	797.78	798.73	799.67	800.62	801.57	802.51	803.46
850	804.40	805.35	806.30	807.24	808.19	809.14	810.08	811.03	811.98	812.92
860	813.87	814.81	815.76	816.71	817.65	818.60	819.55	820.49	821.44	822.39
870	823.33	824.28	825.22	826.17	827.12	828.06	829.01	829.96	830.90	831.85
880	832.80	833.74	834.69	835.63	836.58	837.53	838.47	839.42	840.37	841.31
890	842.26	843.21	844.15	845.10	846.04	846.99	847.94	848.88	849.83	850.78

CAPACITIES — LIQUID QUARTS TO LITERS (Continued)

	0	1	2	3	4	5	6	7	8	9
900	851.72	852.67	853.62	854.56	855.51	856.45	857.40	858.35	859.29	860.24
910	861.19	862.13	863.08	864.03	864.97	865.92	866.86	867.81	868.76	869.70
920	870.65	871.60	872.54	873.49	874.44	875.38	876.33	877.27	878.22	879.17
930	880.11	881.06	882.01	882.95	883.90	884.85	885.79	886.74	887.68	888.63
940	889.53	890.52	891.47	892.42	893.36	894.31	895.26	896.20	897.15	898.09
950	899.04	899.99	900.93	901.88	902.83	903.77	904.72	905.67	906.61	907.56
960	908.50	909.45	910.40	911.34	912.29	913.24	914.18	915.13	916.08	917.02
970	917.97	918.91	919.86	920.81	921.75	922.70	923.65	924.59	925.54	926.49
980	927.43	928.38	929.32	930.27	931.22	932.16	933.11	934.06	935.00	935.95
990	936.90	937.84	938.79	939.73	940.68	941.63	942.57	943.52	944.47	945.41

WEIGHTS — KILOGRAMS TO AVOIRDUPOIS POUNDS

From 1 *to* 1,000 *Units*

Reduction factor: 1 kilogram = 2.204622341 avoirdupois pounds

The values found in the body of the table give, in avoirdupois pounds, the weights indicated in kilograms at the top and side.

	0	1	2	3	4	5	6	7	8	9
0	.....	2.2046	4.4092	6.6139	8.8185	11.023	13.228	15.432	17.637	19.842
10	22.046	24.251	26.455	28.660	30.865	33.069	35.274	37.479	39.683	41.888
20	44.092	46.297	48.502	50.706	52.911	55.116	57.320	59.525	61.729	63.934
30	66.139	68.343	70.548	72.753	74.957	77.162	79.366	81.571	83.776	85.980
40	88.185	90.390	92.594	94.799	97.003	99.208	101.41	103.62	105.82	108.03
50	110.23	112.44	114.64	116.84	119.05	121.25	123.46	125.66	127.87	130.07
60	132.28	134.48	136.69	138.89	141.10	143.30	145.51	147.71	149.91	152.12
70	154.32	156.53	158.73	160.94	163.14	165.35	167.55	169.76	171.96	174.17
80	176.37	178.57	180.78	182.98	185.19	187.39	189.60	191.80	194.01	196.21
90	198.42	200.62	202.83	205.03	207.23	209.44	211.64	213.85	216.05	218.26

WEIGHTS — KILOGRAMS TO AVOIRDUPOIS POUNDS (Continued)

	0	1	2	3	4	5	6	7	8	9
100	220.46	222.67	224.87	227.08	229.28	231.49	233.69	235.89	238.10	240.30
110	242.51	244.71	246.92	249.12	251.33	253.53	255.74	257.94	260.15	262.35
120	264.55	266.76	268.96	271.17	273.37	275.58	277.78	279.99	282.19	284.40
130	286.60	288.81	291.01	293.21	295.42	297.62	299.83	302.03	304.24	306.44
140	308.65	310.85	313.06	315.26	317.47	319.67	321.87	324.08	326.28	328.49
150	330.69	332.90	335.10	337.31	339.51	341.72	343.92	346.13	348.33	350.54
160	352.74	354.94	357.15	359.35	361.56	363.76	365.97	368.17	370.38	372.58
170	374.79	376.99	379.20	381.40	383.60	385.81	388.01	390.22	392.42	394.63
180	396.83	399.04	401.24	403.45	405.65	407.86	410.06	412.26	414.47	416.67
190	418.88	421.08	423.29	425.49	427.70	429.90	432.11	434.31	436.52	438.72
200	440.92	443.13	445.33	447.54	449.74	451.95	454.15	456.36	458.56	460.77
210	462.97	465.18	467.38	469.58	471.79	473.99	476.20	478.40	480.61	482.81
220	485.02	487.22	489.43	491.63	493.84	496.04	498.24	500.45	502.65	504.86
230	507.06	509.27	511.47	513.68	515.88	518.09	520.29	522.50	524.70	526.90
240	529.11	531.31	533.52	535.72	537.93	540.13	542.34	544.54	546.75	548.95
250	551.16	553.36	555.56	557.77	559.97	562.18	564.38	566.59	568.79	571.00
260	573.20	575.41	577.61	579.82	582.02	584.22	586.43	588.63	590.84	593.04
270	595.25	597.45	599.66	601.86	604.07	606.27	608.48	610.68	612.89	615.09
280	617.29	619.50	621.70	623.91	626.11	628.32	630.52	632.73	634.93	637.14
290	639.34	641.55	643.75	645.95	648.16	650.36	652.57	654.77	656.98	659.18

WEIGHTS — KILOGRAMS TO AVOIRDUPOIS POUNDS (Continued)

	0	1	2	3	4	5	6	7	8	9
300	661.39	663.59	665.80	668.00	670.21	672.41	674.61	676.82	679.02	681.23
310	683.43	685.64	687.84	690.05	692.25	694.46	696.66	698.87	701.07	703.27
320	705.48	707.68	709.89	712.09	714.30	716.50	718.71	720.91	723.12	725.32
330	727.53	729.73	731.93	734.14	736.34	738.55	740.75	742.96	745.16	747.37
340	749.57	751.78	753.98	756.19	758.39	760.59	762.80	765.00	767.21	769.41
350	771.62	773.82	776.03	778.23	780.44	782.64	784.85	787.05	789.25	791.46
360	793.66	795.87	798.07	800.28	802.48	804.69	806.89	809.10	811.30	813.51
370	815.71	817.91	820.12	822.32	824.53	826.73	828.94	831.14	833.35	835.55
380	837.76	839.96	842.17	844.37	846.58	848.78	850.98	853.19	855.39	857.60
390	859.80	862.01	864.21	866.42	868.62	870.83	873.03	875.24	877.44	879.64
400	881.85	884.05	886.26	888.46	890.67	892.87	895.08	897.28	899.49	901.69
410	903.90	906.10	908.30	910.51	912.71	914.92	917.12	919.33	921.53	923.74
420	925.94	928.15	930.35	932.56	934.76	936.96	939.17	941.37	943.58	945.78
430	947.99	950.19	952.40	954.60	956.81	959.01	961.22	963.42	965.62	967.83
440	970.03	972.24	974.44	976.65	978.85	981.06	983.26	985.47	987.67	989.88
450	992.08	994.28	996.49	998.69	1,000.9	1,003.1	1,005.3	1,007.5	1,009.7	1,011.9
460	1,014.1	1,016.3	1,018.5	1,020.7	1,022.9	1,025.1	1,027.4	1,029.6	1,031.8	1,034.0
470	1,036.2	1,038.4	1,040.6	1,042.8	1,045.0	1,047.2	1,049.4	1,051.6	1,053.8	1,056.0
480	1,058.2	1,060.4	1,062.6	1,064.8	1,067.0	1,069.2	1,071.4	1,073.7	1,075.9	1,078.1
490	1,080.3	1,082.5	1,084.7	1,086.9	1,089.1	1,091.3	1,093.5	1,095.7	1,097.9	1,100.1

WEIGHTS — KILOGRAMS TO AVOIRDUPOIS POUNDS (Continued)

	0	1	2	3	4	5	6	7	8	9
500	1,102.3	1,104.5	1,106.7	1,108.9	1,111.1	1,113.3	1,115.5	1,117.7	1,119.9	1,122.2
510	1,124.4	1,126.6	1,128.8	1,131.0	1,133.2	1,135.4	1,137.6	1,139.8	1,142.0	1,144.2
520	1,146.4	1,148.6	1,150.8	1,153.0	1,155.2	1,157.4	1,159.6	1,161.8	1,164.0	1,166.2
530	1,168.4	1,170.7	1,172.9	1,175.1	1,177.3	1,179.5	1,181.7	1,183.9	1,186.1	1,188.3
540	1,190.5	1,192.7	1,194.9	1,197.1	1,199.3	1,201.5	1,203.7	1,205.9	1,208.1	1,210.3
550	1,212.5	1,214.7	1,217.0	1,219.2	1,221.4	1,223.6	1,225.8	1,228.0	1,230.2	1,232.4
560	1,234.6	1,236.8	1,239.0	1,241.2	1,243.4	1,245.6	1,247.8	1,250.0	1,252.2	1,254.4
570	1,256.6	1,258.8	1,261.0	1,263.2	1,265.5	1,267.7	1,269.9	1,272.1	1,274.3	1,276.5
580	1,278.7	1,280.9	1,283 1	1,285.3	1,287.5	1,289.7	1,291.9	1,294.1	1,296.3	1,298.5
590	1,300.7	1,302.9	1,305.1	1,307.3	1,309.5	1,311.8	1,314.0	1,316.2	1,318.4	1,320.6
600	1,322.8	1,325.0	1,327.2	1,329.4	1,331.6	1,333.8	1,336.0	1,338.2	1,340.4	1,342.6
610	1,344.8	1,347.0	1,349.2	1,351.4	1,353.6	1,355.8	1,358.0	1,360.3	1,362.5	1,364.7
620	1,366.9	1,369.1	1,371.3	1,373.5	1,375.7	1,377.9	1,380.1	1,382.3	1,384.5	1,386.7
630	1,388.9	1,391.1	1,393.3	1,395.5	1,397.7	1,399.9	1,402.1	1,404.3	1,406.5	1,408.8
640	1,411.0	1,413.2	1,415.4	1,417.6	1,419.8	1,422.0	1,424.2	1,426.4	1,428.6	1,430.8
650	1,433.0	1,435.2	1,437.4	1,439.6	1,441.8	1,444.0	1,446.2	1,448.4	1,450.6	1,452.8
660	1,455.1	1,457.3	1,459.5	1,461.7	1,463.9	1,466.1	1,468.3	1,470.5	1,472.7	1,474.9
670	1,477.1	1,479.3	1,481.5	1,483.7	1,485.9	1,488.1	1,490.3	1,492.5	1,494.7	1,496.9
680	1,499.1	1,501.3	1,503.6	1,505.8	1,508.0	1,510.2	1,512.4	1,514.6	1,516.8	1,519.0
690	1,521.2	1,523.4	1,525.6	1,527.8	1,530.0	1,532.2	1,534.4	1,536.6	1,538.8	1,541.0

WEIGHTS — KILOGRAMS TO AVOIRDUPOIS POUNDS (Continued)

	0	1	2	3	4	5	6	7	8	9
700	1,543.2	1,545.4	1,547.6	1.549.8	1,552.1	1,554.3	1,556.5	1,558.7	1,560.9	1,563.1
710	1,565.3	1,567.5	1,569.7	1,571.9	1,574.1	1,576.3	1,578.5	1,580.7	1,582.9	1,585.1
720	1,587.3	1,589.5	1,591.7	1,593.9	1,596.1	1,598.4	1,600.6	1,602.8	1,605.0	1,607.2
730	1,609.4	1,611.6	1,613.8	1,616.0	1,618.2	1,620.4	1,622.6	1,624.8	1,627.0	1,629.2
740	1,631.4	1,633.6	1,635.8	1,638.0	1,640.2	1,642.4	1,644.6	1,646.9	1,649.1	1,651.3
750	1,653.5	1,655.7	1,657.9	1,660.1	1,662.3	1,664.5	1,666.7	1,668.9	1,671.1	1,673.3
760	1,675.5	1,677.7	1,679.9	1,682.1	1,684.3	1,686.5	1,688.7	1,690.9	1,693.2	1,695.4
770	1,697.6	1,699.8	1,702.0	1,704.2	1,706.4	1,708.6	1,710.8	1,713.0	1,715.2	1,717.4
780	1,719.6	1,721.8	1,724.0	1,726.2	1,728.4	1,730.6	1,732.8	1,735.0	1,737.2	1,739.4
790	1,741.7	1,743.9	1,746.1	1,748.3	1,750.5	1,752.7	1,754.9	1,757.1	1,759.3	1,761.5
800	1,763.7	1,765.9	1,768.1	1,770.3	1,772.5	1,774.7	1,776.9	1,779.1	1,781.3	1,783.5
810	1,785.7	1,787.9	1,790.2	1,792.4	1,794.6	1,796.8	1,799.0	1,801.2	1,803.4	1,805.6
820	1,807.8	1,810.0	1,812.2	1,814.4	1,816.6	1,818.8	1,821.0	1,823.2	1,825.4	1,827.6
830	1,829.8	1,832.0	1,834.2	1,836.5	1,838.7	1,840.9	1,843.1	1,845.3	1,847.5	1,849.7
840	1,851.9	1,854.1	1,856.3	1,858.5	1,860.7	1,862.9	1,865.1	1,867.3	1,869.5	1,871.7
850	1,873.9	1,876.1	1,878.3	1,880.5	1,882.7	1,885.0	1,887.2	1,889.4	1,891.6	1,893.8
860	1,896.0	1,898.2	1,900.4	1,902.6	1,904.8	1,907.0	1,909.2	1,911.4	1,913.6	1,915.8
870	1,918.0	1,920.2	1,922.4	1,924.6	1,926.8	1,929.0	1,931.2	1,933.5	1,935.7	1,937.9
880	1,940.1	1,942.3	1,944.5	1,946.7	1,948.9	1,951.1	1,953.3	1,955.5	1,957.7	1,959.9
890	1,962.1	1,964.3	1,966.5	1,968.7	1,970.9	1,973.1	1,975.3	1,977.5	1,979.8	1,982.0

WEIGHTS — KILOGRAMS TO AVOIRDUPOIS POUNDS (Continued)

	0	1	2	3	4	5	6	7	8	9
900	1,984.2	1,986.4	1,988.6	1,990.8	1,993.0	1,995.2	1,997.4	1,999.6	2,001.8	2,004.0
910	2,006.2	2,008.4	2,010.6	2,012.8	2,015.0	2,017.2	2,019.4	2,021.6	2,023.8	2,026.0
920	2,028.3	2,030.5	2,032.7	2,034.9	2,037.1	2,039.3	2,041.5	2,043.7	2,045.9	2,048.1
930	2,050.3	2,052.5	2,054.7	2,056.9	2,059.1	2,061.3	2,063.5	2,065.7	2,067.9	2,070.1
940	2,072.3	2,074.5	2,076.8	2,079.0	2,081.2	2,083.4	2,085.6	2,087.8	2,090.0	2,092.2
950	2,094.4	2,096.6	2,098.8	2,101.0	2,103.2	2,105.4	2,107.6	2,109.8	2,112.0	2,114.2
960	2,116.4	2,118.6	2,120.8	2,123.1	2,125.3	2,127.5	2,129.7	2,131.9	2,134.1	2,136.3
970	2,138.5	2,140.7	2,142.9	2,145.1	2,147.3	2,149.5	2,151.7	2,153.9	2,156.1	2,158.3
980	2,160.5	2,162.7	2,164.9	2,167.1	2,169.3	2,171.6	2,173.8	2,176.0	2,178.2	2,180.4
990	2,182.6	2,184.8	2,187.0	2,189.2	2,191.4	2,193.6	2,195.8	2,198.0	2,200.2	2,202.4

WEIGHTS — AVOIRDUPOIS POUNDS TO KILOGRAMS

From 1 *to* 1,000 *Units*

Reduction factor: 1 avoirdupois pound = 0.4535924277 kilogram

The values found in the body of the table give, in kilograms, the weights indicated in avoirdupois pounds at the top and side.

	0	1	2	3	4	5	6	7	8	9
0	.....	0.45359	0.90718	1.3608	1.8144	2.2680	2.7216	3.1751	3.6287	4.0823
10	4.5359	4.9895	5.4431	5.8967	6.3503	6.8039	7.2575	7.7111	8.1647	8.6183
20	9.0719	9.5254	9.9790	10.433	10.886	11.340	11.793	12.247	12.701	13.154
30	13.608	14.061	14.515	14.969	15.422	15.876	16.329	16.783	17.237	17.690
40	18.144	18.597	19.051	19.504	19.958	20.412	20.865	21.319	21.772	22.226
50	22.680	23.133	23.587	24.040	24.494	24.948	25.401	25.855	26.308	26.762
60	27.216	27.669	28.123	28.576	29.030	29.484	29.937	30.391	30.844	31.298
70	31.751	32.205	32.659	33.112	33.566	34.019	34.473	34.927	35.380	35.834
80	36.287	36.741	37.195	37.648	38.102	38.555	39.009	39.463	39.916	40.370
90	40.823	41.277	41.731	42.184	42.638	43.091	43.545	43.998	44.452	44.906

WEIGHTS — AVOIRDUPOIS POUNDS TO KILOGRAMS (Continued)

	0	1	2	3	4	5	6	7	8	9
100	45.359	45.813	46.266	46.720	47.174	47.627	48.081	48.534	48.988	49.442
110	49.895	50.349	50.802	51.256	51.710	52.163	52.617	53.070	53.524	53.978
120	54.431	54.885	55.338	55.792	56.245	56.699	57.153	57.606	58.060	58.513
130	58.967	59.421	59.874	60.328	60.781	61.235	61.689	62.142	62.596	63.049
140	63.503	63.957	64.410	64.864	65.317	65.771	66.224	66.678	67.132	67.585
150	68.039	68.492	68.946	69.400	69.853	70.307	70.760	71.214	71.668	72.121
160	72.575	73.028	73.482	73.936	74.389	74.843	75.296	75.750	76.204	76.657
170	77.111	77.564	78.018	78.471	78.925	79.379	79.832	80.286	80.739	81.193
180	81.647	82.100	82.554	83.007	83.461	83.915	84.368	84.822	85.275	85.729
190	86.183	86.636	87.090	87.543	87.997	88.451	88.904	89.358	89.811	90.265
200	90.718	91.172	91.626	92.079	92.533	92.986	93.440	93.894	94.347	94.801
210	95.254	95.708	96.162	96.615	97.069	97.522	97.976	98.430	98.883	99.337
220	99.790	100.24	100.70	101.15	101.60	102.06	102.51	102.97	103.42	103.87
230	104.33	104.78	105.23	105.69	106.14	106.59	107.05	107.50	107.96	108.41
240	108.86	109.32	109.77	110.22	110.68	111.13	111.58	112.04	112.49	112.94
250	113.40	113.85	114.31	114.76	115.21	115.67	116.12	116.57	117.03	117.48
260	117.93	118.39	118.84	119.29	119.75	120.20	120.66	121.11	121.56	122.02
270	122.47	122.92	123.38	123.83	124.28	124.74	125.19	125.65	126.10	126.55
280	127.01	127.46	127.91	128.37	128.82	129.27	129.73	130.18	130.63	131.09
290	131.54	132.00	132.45	132.90	133.36	133.81	134.26	134.72	135.17	135.62

WEIGHTS — AVOIRDUPOIS POUNDS TO KILOGRAMS (Continued)

-	0	1	2	3	4	5	6	7	8	9
300	136.08	136.53	136.98	137.44	137.89	138.35	138.80	139.25	139.71	140.16
310	140.61	141.07	141.52	141.97	142.43	142.88	143.34	143.79	144.24	144.70
320	145.15	145.60	146.06	146.51	146.96	147.42	147.87	148.32	148.78	149.23
330	149.69	150.14	150.59	151.05	151.50	151.95	152.41	152.86	153.31	153.77
340	154.22	154.68	155.13	155.58	156.04	156.49	156.94	157.40	157.85	158.30
350	158.76	159.21	159.66	160.12	160.57	161.03	161.48	161.93	162.39	162.84
360	163.29	163.75	164.20	164.65	165.11	165.56	166.01	166.47	166.92	167.38
370	167.83	168.28	168.74	169.19	169.64	170.10	170.55	171.00	171.46	171.91
380	172.37	172.82	173.27	173.73	174.18	174.63	175.09	175.54	175.99	176.45
390	176.90	177.35	177.81	178.26	178.72	179.17	179.62	180.08	180.53	180.98
400	181.44	181.89	182.34	182.80	183.25	183.70	184.16	184.61	185.07	185.52
410	185.97	186.43	186.88	187.33	187.79	188.24	188.69	189.15	189.60	190.06
420	190.51	190.96	191.42	191.87	192.32	192.78	193.23	193.68	194.14	194.59
430	195.04	195.50	195.95	196.41	196.86	197.31	197.77	198.22	198.67	199.13
440	199.58	200.03	200.49	200.94	201.40	201.85	202.30	202.76	203.21	203.66
450	204.12	204.57	205.02	205.48	205.93	206.38	206.84	207.29	207.75	208.20
460	208.65	209.11	209.56	210.01	210.47	210.92	211.37	211.83	212.28	212.73
470	213.19	213.64	214.10	214.55	215.00	215.46	215.91	216.36	216.82	217.27
480	217.72	218.18	218.63	219.09	219.54	219.99	220.45	220.90	221.35	221.81
490	222.26	222.71	223.17	223.62	224.07	224.53	224.98	225.44	225.89	226.34

WEIGHTS — AVOIRDUPOIS POUNDS TO KILOGRAMS (Continued)

	0	1	2	3	4	5	6	7	8	9
500	226.80	227.25	227.70	228.16	228.61	229.06	229.52	229.97	230.42	230.88
510	231.33	231.79	232.24	232.69	233.15	233.60	234.05	234.51	234.96	235.41
520	235.87	236.32	236.78	237.23	237.68	238.14	238.59	239.04	239.50	239.95
530	240.40	240.86	241.31	241.76	242.22	242.67	243.13	243.58	244.03	244.49
540	244.94	245.39	245.85	246.30	246.75	247.21	247.66	248.12	248.57	249.02
550	249.48	249.93	250.38	250.84	251.29	251.74	252.20	252.65	253.10	253.56
560	254.01	254.47	254.92	255.37	255.83	256.28	256.73	257.19	257.64	258.09
570	258.55	259.00	259.45	259.91	260.36	260.82	261.27	261.72	262.18	262.63
580	263.08	263.54	263.99	264.44	264.90	265.35	265.81	266.26	266.71	267.17
590	267.62	268.07	268.53	268.98	269.43	269.89	270.34	270.79	271.25	271.70
600	272.16	272.61	273.06	273.52	273.97	274.42	274.88	275.33	275.78	276.24
610	276.69	277.14	277.60	278.05	278.51	278.96	279.41	279.87	280.32	280.77
620	281.23	281.68	282.13	282.59	283.04	283.50	283.95	284.40	284.86	285.31
630	285.76	286.22	286.67	287.12	287.58	288.03	288.48	288.94	289.39	289.85
640	290.30	290.75	291.21	291.66	292.11	292.57	293.02	293.47	293.93	294.38
650	294.84	295.29	295.74	296.20	296.65	297.10	297.56	298.01	298.46	298.92
660	299.37	299.82	300.28	300.73	301.19	301.64	302.09	302.55	303.00	303.45
670	303.91	304.36	304.81	305.27	305.72	306.17	306.63	307.08	307.54	307.99
680	308.44	308.90	309.35	309.80	310.26	310.71	311.16	311.62	312.07	312.53
690	312.98	313.43	313.89	314.34	314.79	315.25	315.70	316.15	316.61	317.06

WEIGHTS — AVOIRDUPOIS POUNDS TO KILOGRAMS (Continued)

	0	1	2	3	4	5	6	7	8	9
700	317.51	317.97	318.42	318.88	319.33	319.78	320.24	320.69	321.14	321.60
710	322.05	322.50	322.96	323.41	323.86	324.32	324.77	325.23	325.68	326.13
720	326.59	327.04	327.49	327.95	328.40	328.85	329.31	329.76	330.22	330.67
730	331.12	331.58	332.03	332.48	332.94	333.39	333.84	334.30	334.75	335.20
740	335.66	336.11	336.57	337.02	337.47	337.93	338.38	338.83	339.29	339.74
750	340.19	340.65	341.10	341.56	342.01	342.46	342.92	343.37	343.82	344.28
760	344.73	345.18	345.64	346.09	346.54	347.00	347.45	347.91	348.36	348.81
770	349.27	349.72	350.17	350.63	351.08	351.53	351.99	352.44	352.89	353.35
780	353.80	354.26	354.71	355.16	355.62	356.07	356.52	356.98	357.43	357.88
790	358.34	358.79	359.25	359.70	360.15	360.61	361.06	361.51	361.97	362.42
800	362.87	363.33	363.78	364.23	364.69	365.14	365.60	366.05	366.50	366.96
810	367.41	367.86	368.32	368.77	369.22	369.68	370.13	370.59	371.04	371.49
820	371.95	372.40	372.85	373.31	373.76	374.21	374.67	375.12	375.57	376.03
830	376.48	376.94	377.39	377.84	378.30	378.75	379.20	379.66	380.11	380.56
840	381.02	381.47	381.92	382.38	382.83	383.29	383.74	384.19	384.65	385.10
850	385.55	386.01	386.46	386.91	387.37	387.82	388.28	388.73	389.18	389.64
860	390.09	390.54	391.00	391.45	391.90	392.36	392.81	393.26	393.72	394.17
870	394.63	395.08	395.53	395.99	396.44	396.89	397.35	397.80	398.25	398.71
880	399.16	399.61	400.07	400.52	400.98	401.43	401.88	402.34	402.79	403.24
890	403.70	404.15	404.60	405.06	405.51	405.97	406.42	406.87	407.33	407.78

WEIGHTS — AVOIRDUPOIS POUNDS TO KILOGRAMS (Continued)

	0	1	2	3	4	5	6	7	8	9
900	408.23	408.69	409.14	409.59	410.05	410.50	410.95	411.41	411.86	412.32
910	412.77	413.22	413.68	414.13	414.58	415.04	415.49	415.94	416.40	416.85
920	417.31	417.76	418.21	418.67	419.12	419.57	420.03	420.48	420.93	421.39
930	421.84	422.29	422.75	423.20	423.66	424.11	424.56	425.02	425.47	425.92
940	426.38	426.83	427.28	427.74	428.19	428.64	429.10	429.55	430.01	430.46
950	430.91	431.37	431.82	432.27	432.73	433.18	433.63	434.09	434.54	435.00
960	435.45	435.90	436.36	436.81	437.26	437.72	438.17	438.62	439.08	439.53
970	439.98	440.44	440.89	441.35	441.80	442.25	442.71	443.16	443.61	444.07
980	444.52	444.97	445.43	445.88	446.33	446.79	447.24	447.70	448.15	448.60
990	449.06	449.51	449.96	450.42	450.87	451.32	451.78	452.23	452.69	453.14

CONVERSION OF THERMOMETER SCALES

By I. Gottfried

1

FAHRENHEIT TO CENTIGRADE (WITH CONSTANT, 32.F.) (FROM 1.F. TO 9999.F.)

F.	C.	F.	C.	F.	C.	F.	C.
1	−17.22	10	−12.22	100	37.78	1000	537.78
2	−16.67	20	− 6.67	200	93.33	2000	1093.33
3	−16.11	30	− 1.11	300	148.89	3000	1648.89
4	−15.56	40	+ 4.44	400	204.44	4000	2204.44
5	−15	50	10	500	260	5000	2760
6	−14.44	60	15.56	600	315.56	6000	3315.56
7	−13.89	70	21.11	700	371.11	7000	3871.11
8	−13.33	80	26.67	800	426.67	8000	4426.67
9	−12.78	90	32.22	900	482.22	9000	4982.22

2

FAHRENHEIT TO CENTIGRADE (WITHOUT CONSTANT)

F.	C.	F.	C.	F.	C.	F.	C.
1	.56	10	5.56	100	55.56	1000	555.56
2	1.11	20	11.11	200	111.11	2000	1111.11
3	1.67	30	16.67	300	166.67	3000	1666.67
4	2.22	40	22.22	400	222.22	4000	2222.22
5	2.78	50	27.78	500	277.78	5000	2777.78
6	3.33	60	33.33	600	333.33	6000	3333.33
7	3.89	70	38.89	700	388.89	7000	3888.89
8	4.44	80	44.44	800	444.44	8000	4444.44
9	5.00	90	50.00	900	500.00	9000	5000.00

TO CONVERT DEGREES FAHRENHEIT TO DEGREES CENTIGRADE

Use the first table for one of the digits, and the second table for the others; then add.

Examples: To find the Centigrade equivalent for 35.F.

$$\begin{array}{rcl} 30 & = & 16.67(2) \\ 5 & = & -15 \quad (1) \\ \hline 35.\text{F} & = & 1.67.\text{C} \end{array} \qquad \text{or,} \qquad \begin{array}{rcl} 30 & = & -1.11(1) \\ 5 & = & 2.78(2) \\ \hline 35.\text{F} & = & 1.67.\text{C} \end{array}$$

To find the C. equivalent for 355.F. and 5445.F.

$$\begin{array}{rl} 300 & 148.89(1) \\ 50 & 27.78(2) \\ 5 & 2.78(2) \\ \hline 355.\text{F} & 179.45.\text{C.} \end{array} \qquad \text{or,}$$

CONVERSION OF THERMOMETER SCALES (Continued)

300	166.67(2)	5000	2760 (1)
50	10 (1)	400	222.22(2)
5	2.78(2)	40	22.22(2)
355.F. =	179.45.C.	5	2.78(2)
		5445.F. =	3007.22.C.

1

Centigrade to Fahrenheit (With Constant 32.F.)

C.	F.	C.	F.	C.	F.	C.	F.
				000	32		
1	33.8	10	50	100	212	1000	1832
2	35.6	20	68	200	392	2000	3632
3	37.4	30	86	300	572	3000	5432
4	39.2	40	104	400	752	4000	7232
5	41	50	122	500	932	5000	9032
6	42.8	60	140	600	1112		
7	44.6	70	158	700	1292		
8	46.4	80	176	800	1472		
9	48.2	90	194	900	1652		

2

Centigrade to Fahrenheit (Without Constant)

C.	F.	C.	F.	C.	F.	C.	F.
1	1.8	10	18	100	180	1000	1800
2	3.6	20	36	200	360	2000	3600
3	5.4	30	54	300	540	3000	5400
4	7.2	40	72	400	720	4000	7200
5	9.0	50	90	500	900	5000	9000
6	10.8	60	108	600	1080		
7	12.6	70	126	700	1260		
8	14.4	80	144	800	1440		
9	16.2	90	162	900	1620		

To Convert Degrees Centigrade to Degrees Fahrenhei

Use the first table for one digit, and the second table fo the others; then add.

Examples: To find the Fahrenheit equivalents for 15.C 155.C.; and 5432.C.

10	= 50(1)	18(2)	100	= 212(1)		=180(2)	
5	= 9(2)	or, 41(1)	50	= 90(2)	or,	= 90(2)	
15.C.	= 59.F.	59.F.	5	= 9(2)		41(1)	
			155.C.	= 311.F		= 311.F.	
5000	= 9000(2)		= 9000(2)				
400	= 720(2)	or,	= 752(1)				
30	= 54(2)		= 54(2)				
2	= 35.6(1)		= 3.6(2)				
5432.C.	= 9809.6.F.		= 9809.6.F.				

TEMPERATURES — CENTIGRADE TO FAHRENHEIT

Conversion Table

The values in the body of the table give, in degrees Fahrenheit, the temperatures indicated in degrees Centigrade at the top and side.

1° C. = 1.8° F.

For temperatures below 0° C.

Temp. °C.	0	1	2	3	4	5	6	7	8	9
0	+ 32.0	30.2	28.4	26.6	24.8	23.0	21.2	19.4	17.6	15.8
− 10	+ 14.0	12.2	10.4	8.6	6.8	5.0	3.2	+ 1.4	− 0.4	− 2.2
− 20	− 4.0	5.8	7.6	9.4	11.2	13.0	14.8	16.6	18.4	20.2
− 30	− 22.0	23.8	25.6	27.4	29.2	31.0	32.8	34.6	36.4	38.2
− 40	− 40.0	41.8	43.6	45.4	47.2	49.0	50.8	52.6	54.4	56.2
− 50	− 58.0	59.8	61.6	63.4	65.2	67.0	68.8	70.6	72.4	74.2
− 60	− 76.0	77.8	79.6	81.4	83.2	85.0	86.8	88.6	90.4	92.2
− 70	− 94.0	95.8	97.6	99.4	101.2	103.0	104.8	106.6	108.4	110.2
− 80	− 112.0	113.8	115.6	117.4	119.2	121.0	122.8	124.6	126.4	128.2
− 90	− 130.0	131.8	133.6	135.4	137.2	139.0	140.8	142.6	144.4	146.2

TEMPERATURES — CENTIGRADE TO FAHRENHEIT (Continued)

Temp. °C.	0	1	2	3	4	5	6	7	8	9
−100	−148.0	149.8	151.6	153.4	155.2	157.0	158.8	160.6	162.4	164.2
−110	−166.0	167.8	169.6	171.4	173.2	175.0	176.8	178.6	180.4	182.2
−120	−184.0	185.8	187.6	189.4	191.2	193.0	194.8	196.6	198.4	200.2
−130	−202.0	203.8	205.6	207.4	209.2	211.0	212.8	214.6	216.4	218.2
−140	−220.0	221.8	223.6	225.4	227.2	229.0	230.8	232.6	234.4	236.2
−150	−238.0	239.8	241.6	243.4	245.2	247.0	248.8	250.6	252.4	254.2
−160	−256.0	257.8	259.6	261.4	263.2	265.0	266.8	268.6	270.4	272.2
−170	−274.0	275.8	277.6	279.4	281.2	283.0	284.8	286.6	288.4	290.2
−180	−292.0	293.8	295.6	297.4	299.2	301.0	302.8	304.6	306.4	308.2
−190	−310.0	311.8	313.6	315.4	317.2	319.0	320.8	322.6	324.4	326.2
−200	−328.0	329.8	331.6	333.4	335.2	337.0	338.8	340.6	342.4	344.2
−210	−346.0	347.8	349.6	351.4	353.2	355.0	356.8	358.6	360.4	362.2
−220	−364.0	365.8	367.6	369.4	371.2	373.0	374.8	376.6	378.4	380.2
−230	−382.0	383.8	385.6	387.4	389.2	391.0	392.8	394.6	396.4	398.2
−240	−400.0	401.8	403.6	405.4	407.2	409.0	410.8	412.6	414.4	416.2
−250	−418.0	419.8	421.6	423.4	425.2	427.0	428.8	430.6	432.4	434.2
−260	−436.0	437.8	439.6	441.4	443.2	445.0	446.8	448.6	450.4	452.2
−270	−454.0	455.8	457.6	459.4	.....	.....	.....	.....	.....	.....

−273° C. = −459.4° F. = absolute zero

For											
	°C	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
interpolation	°F	0.18	0.36	0.54	0.72	0.90	1.08	1.26	1.44	1.62	1.80

TEMPERATURES — CENTIGRADE TO FAHRENHEIT (Continued)

Conversion Table

For temperatures above 0° C.

Temp. °C.	0	1	2	3	4	5	6	7	8	9
0	32.0	33.8	35.6	37.4	39.2	41.0	42.8	44.6	46.4	48.2
10	50.0	51.8	53.6	55.4	57.2	59.0	60.8	62.6	64.4	66.2
20	68.0	69.8	71.6	73.4	75.2	77.0	78.8	80.6	82.4	84.2
30	86.0	87.8	89.6	91.4	93.2	95.0	96.8	98.6	100.4	102.2
40	104.0	105.8	107.6	109.4	111.2	113.0	114.8	116.6	118.4	120.2
50	122.0	123.8	125.6	127.4	129.2	131.0	132.8	134.6	136.4	138.2
60	140.0	141.8	143.6	145.4	147.2	149.0	150.8	152.6	154.4	156.2
70	158.0	159.8	161.6	163.4	165.2	167.0	168.8	170.6	172.4	174.2
80	176.0	177.8	179.6	181.4	183.2	185.0	186.8	188.6	190.4	192.2
90	194.0	195.8	197.6	199.4	201.2	203.0	204.8	206.6	208.4	210.2
100	212.0	213.8	215.6	217.4	219.2	221.0	222.8	224.6	226.4	228.2
110	230.0	231.8	233.6	235.4	237.2	239.0	240.8	242.6	244.4	246.2
120	248.0	249.8	251.6	253.4	255.2	257.0	258.8	260.6	262.4	264.2
130	266.0	267.8	269.6	271.4	273.2	275.0	276.8	278.6	280.4	282.2
140	284.0	285.8	287.6	289.4	291.2	293.0	294.8	296.6	298.4	300.2
150	302.0	303.8	305.6	307.4	309.2	311.0	312.8	314.6	316.4	318.2
160	320.0	321.8	323.6	325.4	327.2	329.0	330.8	332.6	334.4	336.2
170	338.0	339.8	341.6	343.4	345.2	347.0	348.8	350.6	352.4	354.2
180	356.0	357.8	359.6	361.4	363.2	365.0	366.8	368.6	370.4	372.2
190	374.0	375.8	377.6	379.4	381.2	383.0	384.8	386.6	388.4	390.2

TEMPERATURES — CENTIGRADE TO FAHRENHEIT (Continued)

Temp. °C.	0	1	2	3	4	5	6	7	8	9
200	392.0	393.8	395.6	397.4	399.2	401.0	402.8	404.6	406.4	408.2
210	410.0	411.8	413.6	415.4	417.2	419.0	420.8	422.6	424.4	426.2
220	428.0	429.8	431.6	433.4	435.2	437.0	438.8	440.6	442.4	444.2
230	446.0	447.8	449.6	451.4	453.2	455.0	456.8	458.6	460.4	462.2
240	464.0	465.8	467.6	469.4	471.2	473.0	474.8	476.6	478.4	480.2
250	482.0	483.8	485.6	487.4	489.2	491.0	492.8	494.6	496.4	498.2
260	500.0	501.8	503.6	505.4	507.2	509.0	510.8	512.6	514.4	516.2
270	518.0	519.8	521.6	523.4	525.2	527.0	528.8	530.6	532.4	534.2
280	536.0	537.8	539.6	541.4	543.2	545.0	546.8	548.6	550.4	552.2
290	554.0	555.8	557.6	559.4	561.2	563.0	564.8	566.6	568.4	570.2
300	572.0	573.8	575.6	577.4	579.2	581.0	582.8	584.6	586.4	588.2
310	590.0	591.8	593.6	595.4	597.2	599.0	600.8	602.6	604.4	606.2
320	608.0	609.8	611.6	613.4	615.2	617.0	618.8	620.6	622.4	624.2
330	626.0	627.8	629.6	631.4	633.2	635.0	636.8	638.6	640.4	642.2
340	644.0	645.8	647.6	649.4	651.2	653.0	654.8	656.6	658.4	660.2
350	662.0	663.8	665.6	667.4	669.2	671.0	672.8	674.6	676.4	678.2
360	680.0	681.8	683.6	685.4	687.2	689.0	690.8	692.6	694.4	696.2
370	698.0	699.8	701.6	703.4	705.2	707.0	708.8	710.6	712.4	714.2
380	716.0	717.8	719.6	721.4	723.2	725.0	726.8	728.6	730.4	732.2
390	734.0	735.8	737.6	739.4	741.2	743.0	744.8	746.6	748.4	750.2

For interpolation											
	°C	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
	°F	0.18	0.36	0.54	0.72	0.90	1.08	1.26	1.44	1.62	1.80

TEMPERATURES — CENTIGRADE TO FAHRENHEIT (Continued)

Conversion Table

For temperatures above 0° C.

Temp. °C.	0	1	2	3	4	5	6	7	8	9
400	752.0	753.8	755.6	757.4	759.2	761.0	762.8	764.6	766.4	768.2
410	770.0	771.8	773.6	775.4	777.2	779.0	780.8	782.6	784.4	786.2
420	788.0	789.8	791.6	793.4	795.2	797.0	798.8	800.6	802.4	804.2
430	806.0	807.8	809.6	811.4	813.2	815.0	816.8	818.6	820.4	822.2
440	824.0	825.8	827.6	829.4	831.2	833.0	834.8	836.6	838.4	840.2
450	842.0	843.8	845.6	847.4	849.2	851.0	852.8	854.6	856.4	858.2
460	860.0	861.8	863.6	865.4	867.2	869.0	870.8	872.6	874.4	876.2
470	878.0	879.8	881.6	883.4	885.2	887.0	888.8	890.6	892.4	894.2
480	896.0	897.8	899.6	901.4	903.2	905.0	906.8	908.6	910.4	912.2
490	914.0	915.8	917.6	919.4	921.2	923.0	924.8	926.6	928.4	930.2
500	932.0	933.8	935.6	937.4	939.2	941.0	942.8	944.6	946.4	948.2
510	950.0	951.8	953.6	955.4	957.2	959.0	960.8	962.6	964.4	966.2
520	968.0	969.8	971.6	973.4	975.2	977.0	978.8	980.6	982.4	984.2
530	986.0	987.8	989.6	991.4	993.2	995.0	996.8	998.6	1000.4	1002.2
540	1004.0	1005.8	1007.6	1009.4	1011.2	1013.0	1014.8	1016.6	1018.4	1020.2
550	1022.0	1023.8	1025.6	1027.4	1029.2	1031.0	1032.8	1034.6	1036.4	1038.2
560	1040.0	1041.8	1043.6	1045.4	1047.2	1049.0	1050.8	1052.6	1054.4	1056.2
570	1058.0	1059.8	1061.6	1063.4	1065.2	1067.0	1068.8	1070.6	1072.4	1074.2
580	1076.0	1077.8	1079.6	1081.4	1083.2	1085.0	1086.8	1088.6	1090.4	1092.2
590	1094.0	1095.8	1097.6	1099.4	1101.2	1103.0	1104.8	1106.6	1108.4	1110.2

TEMPERATURES — CENTIGRADE TO FAHRENHEIT (Continued)

Temp. °C.	0	1	2	3	4	5	6	7	8	9
600	1112.0	1113.8	1115.6	1117.4	1119.2	1121.0	1122.8	1124.6	1126.4	1128.2
610	1130.0	1131.8	1133.6	1135.4	1137.2	1139.0	1140.8	1142.6	1144.4	1146.2
620	1148.0	1149.8	1151.6	1153.4	1155.2	1157.0	1158.8	1160.6	1162.4	1164.2
630	1166.0	1167.8	1169.6	1171.4	1173.2	1175.0	1176.8	1178.6	1180.4	1182.2
640	1184.0	1185.8	1187.6	1189.4	1191.2	1193.0	1194.8	1196.6	1198.4	1200.2
650	1202.0	1203.8	1205.6	1207.4	1209.2	1211.0	1212.8	1214.6	1216.4	1218.2
660	1220.0	1221.8	1223.6	1225.4	1227.2	1229.0	1230.8	1232.6	1234.4	1236.2
670	1238.0	1239.8	1241.6	1243.4	1245.2	1247.0	1248.8	1250.6	1252.4	1254.2
680	1256.0	1257.8	1259.6	1261.4	1263.2	1265.0	1266.8	1268.6	1270.4	1272.2
690	1274.0	1275.8	1277.6	1279.4	1281.2	1283.0	1284.8	1286.6	1288.4	1290.2
700	1292.0	1293.8	1295.6	1297.4	1299.2	1301.0	1302.8	1304.6	1306.4	1308.2
710	1310.0	1311.8	1313.6	1315.4	1317.2	1319.0	1320.8	1322.6	1324.4	1326.2
720	1328.0	1329.8	1331.6	1333.4	1335.2	1337.0	1338.8	1340.6	1342.4	1344.2
730	1346.0	1347.8	1349.6	1351.4	1353.2	1355.0	1356.8	1358.6	1360.4	1362.2
740	1364.0	1365.8	1367.6	1369.4	1371.2	1373.0	1374.8	1376.6	1378.4	1380.2
750	1382.0	1383.8	1385.6	1387.4	1389.2	1391.0	1392.8	1394.6	1396.4	1398.2
760	1400.0	1401.8	1403.6	1405.4	1407.2	1409.0	1410.8	1412.6	1414.4	1416.2
770	1418.0	1419.8	1421.6	1423.4	1425.2	1427.0	1428.8	1430.6	1432.4	1434.2
780	1436.0	1437.8	1439.6	1441.4	1443.2	1445.0	1446.8	1448.6	1450.4	1452.2
790	1454.0	1455.8	1457.6	1459.4	1461.2	1463.0	1464.8	1466.6	1468.4	1470.2

For interpolation											
	°C	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
	°F	0.18	0.36	0.54	0.72	0.90	1.08	1.26	1.44	1.62	1.80

TEMPERATURES — CENTIGRADE TO FAHRENHEIT (Continued)

Conversion Table

For temperatures above 0° C.

Temp. °C.	0	1	2	3	4	5	6	7	8	9
800	1472.0	1473.8	1475.6	1477.4	1479.2	1481.0	1482.8	1484.6	1486.4	1488.2
810	1490.0	1491.8	1493.6	1495.4	1497.2	1499.0	1500.8	1502.6	1504.4	1506.2
820	1508.0	1509.8	1511.6	1513.4	1515.2	1517.0	1518.8	1520.6	1522.4	1524.2
830	1526.0	1527.8	1529.6	1531.4	1533.2	1535.0	1536.8	1538.6	1540.4	1542.2
840	1544.0	1545.8	1547.6	1549.4	1551.2	1553.0	1554.8	1556.6	1558.4	1560.2
850	1562.0	1563.8	1565.6	1567.4	1569.2	1571.0	1572.8	1574.6	1576.4	1578.2
860	1580.0	1581.8	1583.6	1585.4	1587.2	1589.0	1590.8	1592.6	1594.4	1596.2
870	1598.0	1599.8	1601.6	1603.4	1605.2	1607.0	1608.8	1610.6	1612.4	1614.2
880	1616.0	1617.8	1619.6	1621.4	1623.2	1625.0	1626.8	1628.6	1630.4	1632.2
890	1634.0	1635.8	1637.6	1639.4	1641.2	1643.0	1644.8	1646.6	1648.4	1650.2
900	1652.0	1653.8	1655.6	1657.4	1659.2	1661.0	1662.8	1664.6	1666.4	1668.2
910	1670.0	1671.8	1673.6	1675.4	1677.2	1679.0	1680.8	1682.6	1684.4	1686.2
920	1688.0	1689.8	1691.6	1693.4	1695.2	1697.0	1698.8	1700.6	1702.4	1704.2
930	1706.0	1707.8	1709.6	1711.4	1713.2	1715.0	1716.8	1718.6	1720.4	1722.2
940	1724.0	1725.8	1727.6	1729.4	1731.2	1733.0	1734.8	1736.6	1738.4	1740.2
950	1742.0	1743.8	1745.6	1747.4	1749.2	1751.0	1752.8	1754.6	1756.4	1758.2
960	1760.0	1761.8	1763.6	1765.4	1767.2	1769.0	1770.8	1772.6	1774.4	1776.2
970	1778.0	1779.8	1781.6	1783.4	1785.2	1787.0	1788.8	1790.6	1792.4	1794.2
980	1796.0	1797.8	1799.6	1801.4	1803.2	1805.0	1806.8	1808.6	1810.4	1812.2
990	1814.0	1815.8	1817.6	1819.4	1821.2	1823.0	1824.8	1826.6	1828.4	1830.2

TEMPERATURES — CENTIGRADE TO FAHRENHEIT (Continued)

Temp. °C.	0	1	2	3	4	5	6	7	8	9
1000	1832.0	1833.8	1835.6	1837.4	1839.2	1841.0	1842.8	1844.6	1846.4	1848.2
1010	1850.0	1851.8	1853.6	1855.4	1857.2	1859.0	1860.8	1862.6	1864.4	1866.2
1020	1868.0	1869.8	1871.6	1873.4	1875.2	1877.0	1878.8	1880.6	1882.4	1884.2
1030	1886.0	1887.8	1889.6	1891.4	1893.2	1895.0	1896.8	1898.6	1900.4	1902.2
1040	1904.0	1905.8	1907.6	1909.4	1911.2	1913.0	1914.8	1916.6	1918.4	1920.2
1050	1922.0	1923.8	1925.6	1927.4	1929.2	1931.0	1932.8	1934.6	1936.4	1938.2
1060	1940.0	1941.8	1943.6	1945.4	1947.2	1949.0	1950.8	1952.6	1954.4	1956.2
1070	1958.0	1959.8	1961.6	1963.4	1965.2	1967.0	1968.8	1970.6	1972.4	1974.2
1080	1976.0	1977.8	1979.6	1981.4	1983.2	1985.0	1986.8	1988.6	1990.4	1992.2
1090	1994.0	1995.8	1997.6	1999.4	2001.2	2003.0	2004.8	2006.6	2008.4	2010.2
1100	2012.0	2013.8	2015.6	2017.4	2019.2	2021.0	2022.8	2024.6	2026.4	2028.2
1110	2030.0	2031.8	2033.6	2035.4	2037.2	2039.0	2040.8	2042.6	2044.4	2046.2
1120	2048.0	2049.8	2051.6	2053.4	2055.2	2057.0	2058.8	2060.6	2062.4	2064.2
1130	2066.0	2067.8	2069.6	2071.4	2073.2	2075.0	2076.8	2078.6	2080.4	2082.2
1140	2084.0	2085.8	2087.6	2089.4	2091.2	2093.0	2094.8	2096.6	2098.4	2100.2
1150	2102.0	2103.8	2105.6	2107.4	2109.2	2111.0	2112.8	2114.6	2116.4	2118.2
1160	2120.0	2121.8	2123.6	2125.4	2127.2	2129.0	2130.8	2132.6	2134.4	2136.2
1170	2138.0	2139.8	2141.6	2143.4	2145.2	2147.0	2148.8	2150.6	2152.4	2154.2
1180	2156.0	2157.8	2159.6	2161.4	2163.2	2165.0	2166.8	2168.6	2170.4	2172.2
1190	2174.0	2175.8	2177.6	2179.4	2181.2	2183.0	2184.8	2186.6	2188.4	2190.2

For interpolation	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
°C										
°F	0.18	0.36	0.54	0.72	0.90	1.08	1.26	1.44	1.62	1.80

TEMPERATURES — CENTIGRADE TO FAHRENHEIT (Continued)

Conversion Table

For temperatures above 0° C.

Temp. °C.	0	1	2	3	4	5	6	7	8	9
1200	2192.0	2193.8	2195.6	2197.4	2199.2	2201.0	2202.8	2204.6	2206.4	2208.2
1210	2210.0	2211.8	2213.6	2215.4	2217.2	2219.0	2220.8	2222.6	2224.4	2226.2
1220	2228.0	2229.8	2231.6	2233.4	2235.2	2237.0	2238.8	2240.6	2242.4	2244.2
1230	2246.0	2247.8	2249.6	2251.4	2253.2	2255.0	2256.8	2258.6	2260.4	2262.2
1240	2264.0	2265.8	2267.6	2269.4	2271.2	2273.0	2274.8	2276.6	2278.4	2280.2
1250	2282.0	2283.8	2285.6	2287.4	2289.2	2291.0	2292.8	2294.6	2296.4	2298.2
1260	2300.0	2301.8	2303.6	2305.4	2307.2	2309.0	2310.8	2312.6	2314.4	2316.2
1270	2318.0	2319.8	2321.6	2323.4	2325.2	2327.0	2328.8	2330.6	2332.4	2334.2
1280	2336.0	2337.8	2339.6	2341.4	2343.2	2345.0	2346.8	2348.6	2350.4	2352.2
1290	2354.0	2355.8	2357.6	2359.4	2361.2	2363.0	2364.8	2366.6	2368.4	2370.2
1300	2372.0	2373.8	2375.6	2377.4	2379.2	2381.0	2382.8	2384.6	2386.4	2388.2
1310	2390.0	2391.8	2393.6	2395.4	2397.2	2399.0	2400.8	2402.6	2404.4	2406.2
1320	2408.0	2409.8	2411.6	2413.4	2415.2	2417.0	2418.8	2420.6	2422.4	2424.2
1330	2426.0	2427.8	2429.6	2431.4	2433.2	2435.0	2436.8	2438.6	2440.4	2442.2
1340	2444.0	2445.8	2447.6	2449.4	2451.2	2453.0	2454.8	2456.6	2458.4	2460.2
1350	2462.0	2463.8	2465.6	2467.4	2469.2	2471.0	2472.8	2474.6	2476.4	2478.2
1360	2480.0	2481.8	2483.6	2485.4	2487.2	2489.0	2490.8	2492.6	2494.4	2496.2
1370	2498.0	2499.8	2501.6	2503.4	2505.2	2507.0	2508.8	2510.6	2512.4	2514.2
1380	2516.0	2517.8	2519.6	2521.4	2523.2	2525.0	2526.8	2528.6	2530.4	2532.2
1390	2534.0	2535.8	2537.6	2539.4	2541.2	2543.0	2544.8	2546.6	2548.4	2550.2

TEMPERATURES— CENTIGRADE TO FAHRENHEIT (Continued)

Temp. °C.	0	1	2	3	4	5	6	7	8	9
1400	2552.0	2553.8	2555.6	2557.4	2559.2	2561.0	2562.8	2564.6	2566.4	2568.2
1410	2570.0	2571.8	2573.6	2575.4	2577.2	2579.0	2580.8	2582.6	2584.4	2586.2
1420	2588.0	2589.8	2591.6	2593.4	2595.2	2597.0	2598.8	2600.6	2602.4	2604.2
1430	2606.0	2607.8	2609.6	2611.4	2613.2	2615.0	2616.8	2618.6	2620.4	2622.2
1440	2624.0	2625.8	2627.6	2629.4	2631.2	2633.0	2634.8	2636.6	2638.4	2640.2
1450	2642.0	2643.8	2645.6	2647.4	2649.2	2651.0	2652.8	2654.6	2656.4	2658.2
1460	2660.0	2661.8	2663.6	2665.4	2667.2	2669.0	2670.8	2672.6	2674.4	2676.2
1470	2678.0	2679.8	2681.6	2683.4	2685.2	2687.0	2688.8	2690.6	2692.4	2694.2
1480	2696.0	2697.8	2699.6	2701.4	2703.2	2705.0	2706.8	2708.6	2710.4	2712.2
1490	2714.0	2715.8	2717.6	2719.4	2721.2	2723.0	2724.8	2726.6	2728.4	2730.2
1500	2732.0	2733.8	2735.6	2737.4	2739.2	2741.0	2742.8	2744.6	2746.4	2748.2
1510	2750.0	2751.8	2753.6	2755.4	2757.2	2759.0	2760.8	2762.6	2764.4	2766.2
1520	2768.0	2769.8	2771.6	2773.4	2775.2	2777.0	2778.8	2780.6	2782.4	2784.2
1530	2786.0	2787.8	2789.6	2791.4	2793.2	2795.0	2796.8	2798.6	2800.4	2802.2
1540	2804.0	2805.8	2807.6	2809.4	2811.2	2813.0	2814.8	2816.6	2818.4	2820.2
1550	2822.0	2823.8	2825.6	2827.4	2829.2	2831.0	2832.8	2834.6	2836.4	2838.2
1560	2840.0	2841.8	2843.6	2845.4	2847.2	2849.0	2850.8	2852.6	2854.4	2856.2
1570	2858.0	2859.8	2861.6	2863.4	2865.2	2867.0	2868.8	2870.6	2872.4	2874.2
1580	2876.0	2877.8	2879.6	2881.4	2883.2	2885.0	2886.8	2888.6	2890.4	2892.2
1590	2894.0	2895.8	2897.6	2899.4	2901.2	2903.0	2904.8	2906.6	2908.4	2910.2

For interpolation											
	°C	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
	°F	0.18	0.36	0.54	0.72	0.90	1.08	1.26	1.44	1.62	1.80

TEMPERATURES — CENTIGRADE TO FAHRENHEIT (Continued)

Conversion Table

For temperatures above 0° C.

Temp. °C.	0	1	2	3	4	5	6	7	8	9
1600	2912.0	2913.8	2915.6	2917.4	2919.2	2921.0	2922.8	2924.6	2926.4	2928.2
1610	2930.0	2931.8	2933.6	2935.4	2937.2	2939.0	2940.8	2942.6	2944.4	2946.2
1620	2948.0	2949.8	2951.6	2953.4	2955.2	2957.0	2958.8	2960.6	2962.4	2964.2
1630	2966.0	2967.8	2969.6	2971.4	2973.2	2975.0	2976.8	2978.6	2980.4	2982.2
1640	2984.0	2985.8	2987.6	2989.4	2991.2	2993.0	2994.8	2996.6	2998.4	3000.2
1650	3002.0	3003.8	3005.6	3007.4	3009.2	3011.0	3012.8	3014.6	3016.4	3018.2
1660	3020.0	3021.8	3023.6	3025.4	3027.2	3029.0	3030.8	3032.6	3034.4	3036.2
1670	3038.0	3039.8	3041.6	3043.4	3045.2	3047.0	3048.8	3050.6	3052.4	3054.2
1680	3056.0	3057.8	3059.6	3061.4	3063.2	3065.0	3066.8	3068.6	3070.4	3072.2
1690	3074.0	3075.8	3077.6	3079.4	3081.2	3083.0	3084.8	3086.6	3088.4	3090.2
1700	3092.0	3093.8	3095.6	3097.4	3099.2	3101.0	3102.8	3104.6	3106.4	3108.2
1710	3110.0	3111.8	3113.6	3115.4	3117.2	3119.0	3120.8	3122.6	3124.4	3126.2
1720	3128.0	3129.8	3131.6	3133.4	3135.2	3137.0	3138.8	3140.6	3142.4	3144.2
1730	3146.0	3147.8	3149.6	3151.4	3153.2	3155.0	3156.8	3158.6	3160.4	3162.2
1740	3164.0	3165.8	3167.6	3169.4	3171.2	3173.0	3174.8	3176.6	3178.4	3180.2
1750	3182.0	3183.8	3185.6	3187.4	3189.2	3191.0	3192.8	3194.6	3196.4	3198.2
1760	3200.0	3201.8	3203.6	3205.4	3207.2	3209.0	3210.8	3212.6	3214.4	3216.2
1770	3218.0	3219.8	3221.6	3223.4	3225.2	3227.0	3228.8	3230.6	3232.4	3234.2
1780	3236.0	3237.8	3239.6	3241.4	3243.2	3245.0	3246.8	3248.6	3250.4	3252.2
1790	3254.0	3255.8	3257.6	3259.4	3261.2	3263.0	3264.8	3266.6	3268.4	3270.2

TEMPERATURES— CENTIGRADE TO FAHRENHEIT (Continued)

Temp. °C.	0	1	2	3	4	5	6	7	8	9
1800	3272.0	3273.8	3275.6	3277.4	3279.2	3281.0	3282.8	3284.6	3286.4	3288.2
1810	3290.0	3291.8	3293.6	3295.4	3297.2	3299.0	3300.8	3302.6	3304.4	3306.2
1820	3308.0	3309.8	3311.6	3313.4	3315.2	3317.0	3318.8	3320.6	3322.4	3324.2
1830	3326.0	3327.8	3329.6	3331.4	3333.2	3335.0	3336.8	3338.6	3340.4	3342.2
1840	3344.0	3345.8	3347.6	3349.4	3351.2	3353.0	3354.8	3356.6	3358.4	3360.2
1850	3362.0	3363.8	3365.6	3367.4	3369.2	3371.0	3372.8	3374.6	3376.4	3378.2
1860	3380.0	3381.8	3383.6	3385.4	3387.2	3389.0	3390.8	3392.6	3394.4	3396.2
1870	3398.0	3399.8	3401.6	3403.4	3405.2	3407.0	3408.8	3410.6	3412.4	3414.2
1880	3416.0	3417.8	3419.6	3421.4	3423.2	3425.0	3426.8	3428.6	3430.4	3432.2
1890	3434.0	3435.8	3437.6	3439.4	3441.2	3443.0	3444.8	3446.6	3448.4	3450.2
1900	3452.0	3453.8	3455.6	3457.4	3459.2	3461.0	3462.8	3464.6	3466.4	3468.2
1910	3470.0	3471.8	3473.6	3475.4	3477.2	3479.0	3480.8	3482.6	3484.4	3486.2
1920	3488.0	3489.8	3491.6	3493.4	3495.2	3497.0	3498.8	3500.6	3502.4	3504.2
1930	3506.0	3507.8	3509.6	3511.4	3513.2	3515.0	3516.8	3518.6	3520.4	3522.2
1940	3424.0	3525.8	3527.6	3529.4	3531.2	3533.0	3534.8	3536.6	3538.4	3540.2
1950	3542.0	3543.8	3545.6	3547.4	3549.2	3551.0	3552.8	3554.6	3556.4	3558.2
1960	3560.0	3561.8	3563.6	3565.4	3567.2	3569.0	3570.8	3572.6	3574.4	3576.2
1970	3578.0	3579.8	3581.6	3583.4	3585.2	3587.0	3588.8	3590.6	3592.4	3594.2
1980	3596.0	3597.8	3599.6	3601.4	3603.2	3605.0	3606.8	3608.6	3610.4	3612.2
1990	3614.0	3615.8	3617.6	3619.4	3621.2	3623.0	3624.8	3626.6	3628.4	3630.2

For	°C	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
	°F	0.18	0.36	0.54	0.72	0.90	1.08	1.26	1.44	1.62	1.80

TEMPERATURES — CENTIGRADE TO FAHRENHEIT (Continued)

Conversion Table

For temperatures above 0° C.

Temp. °C.	0	1	2	3	4	5	6	7	8	9
2000	3632.0	3633.8	3635.6	3637.4	3639.2	3641.0	3642.8	3644.6	3646.4	3648.2
2010	3650.0	3651.8	3653.6	3655.4	3657.2	3659.0	3660.8	3662.6	3664.4	3666.2
2020	3668.0	3669.8	3671.6	3673.4	3675.2	3677.0	3678.8	3680.6	3682.4	3684.2
2030	3686.0	3687.8	3689.6	3691.4	3693.2	3695.0	3696.8	3698.6	3700.4	3702.2
2040	3704.0	3705.8	3707.6	3709.4	3711.2	3713.0	3714.8	3716.6	3718.4	3720.2
2050	3722.0	3723.8	3725.6	3727.4	3729.2	3731.0	3732.8	3734.6	3736.4	3738.2
2060	3740.0	3741.8	3743.6	3745.4	3747.2	3749.0	3750.8	3752.6	3754.4	3756.2
2070	3758.0	3759.8	3761.6	3763.4	3765.2	3767.0	3768.8	3770.6	3772.4	3774.2
2080	3776.0	3777.8	3779.6	3781.4	3783.2	3785.0	3786.8	3788.6	3790.4	3792.2
2090	3794.0	3795.8	3797.6	3799.4	3801.2	3803.0	3804.8	3806.6	3808.4	3810.2
2100	3812.0	3813.8	3815.6	3817.4	3819.2	3821.0	3822.8	3824.6	3826.4	3828.2
2110	3830.0	3831.8	3833.6	3835.4	3837.2	3839.0	3840.8	3842.6	3844.4	3846.2
2120	3848.0	3849.8	3851.6	3853.4	3855.2	3857.0	3858.8	3860.6	3862.4	3864.2
2130	3866.0	3867.8	3869.6	3871.4	3873.2	3875.0	3876.8	3878.6	3880.4	3882.2
2140	3884.0	3885.8	3887.6	3889.4	3891.2	3893.0	3894.8	3896.6	3898.4	3900.2
2150	3902.0	3903.8	3905.6	3907.4	3909.2	3911.0	3912.8	3914.6	3916.4	3918.2
2160	3920.0	3921.8	3923.6	3925.4	3927.2	3929.0	3930.8	3932.6	3934.4	3936.2
2170	3938.0	3939.8	3941.6	3943.4	3945.2	3947.0	3948.8	3950.6	3952.4	3954.2
2180	3956.0	3957.8	3959.6	3961.4	3963.2	3965.0	3966.8	3968.6	3970.4	3972.2
2190	3974.0	3975.8	3977.6	3979.4	3981.2	3983.0	3984.8	3986.6	3988.4	3990.2

TEMPERATURES— CENTIGRADE TO FAHRENHEIT (Continued)

Temp. °C.	0	1	2	3	4	5	6	7	8	9
2200	3992.0	3993.8	3995.6	3997.4	3999.2	4001.0	4002.8	4004.6	4006.4	4008.2
2210	4010.0	4011.8	4013.6	4015.4	4017.2	4019.0	4020.8	4022.6	4024.4	4026.2
2220	4028.0	4029.8	4031.6	4033.4	4035.2	4037.0	4038.8	4040.6	4042.4	4044.2
2230	4046.0	4047.8	4049.6	4051.4	4053.2	4055.0	4056.8	4058.6	4060.4	4062.2
2240	4064.0	4065.8	4067.6	4069.4	4071.2	4073.0	4074.8	4076.6	4078.4	4080.2
2250	4082.0	4083.8	4085.6	4087.4	4089.2	4091.0	4092.8	4094.6	4096.4	4098.2
2260	4100.0	4101.8	4103.6	4105.4	4107.2	4109.0	4110.8	4112.6	4114.4	4116.2
2270	4118.0	4119.8	4121.6	4123.4	4125.2	4127.0	4128.8	4130.6	4132.4	4134.2
2280	4136.0	4137.8	4139.6	4141.4	4143.2	4145.0	4146.8	4148.6	4150.4	4152.2
2290	4154.0	4155.8	4157.6	4159.4	4161.2	4163.0	4164.8	4166.6	4168.4	4170.2
2300	4172.0	4173.8	4175.6	4177.4	4179.2	4181.0	4182.8	4184.6	4186.4	4188.2
2310	4190.0	4191.8	4193.6	4195.4	4197.2	4199.0	4200.8	4202.6	4204.4	4206.2
2320	4208.0	4209.8	4211.6	4213.4	4215.2	4217.0	4218.8	4220.6	4222.4	4224.2
2330	4226.0	4227.8	4229.6	4231.4	4233.2	4235.0	4236.8	4238.6	4240.4	4242.2
2340	4244.0	4245.8	4247.6	4249.4	4251.2	4253.0	4254.8	4256.6	4258.4	4260.2
2350	4262.0	4263.8	4265.6	4267.4	4269.2	4271.0	4272.8	4274.6	4276.4	4278.2
2360	4280.0	4281.8	4383.6	4285.4	4287.2	4289.0	4290.8	4292.6	4294.4	4296.2
2370	4298.0	4299.8	4301.6	4303.4	4305.2	4307.0	4308.8	4310.6	4312.4	4314.2
2380	4316.0	4317.8	4319.6	4321.4	4323.2	4325.0	4326.8	4328.6	4330.4	4332.2
2390	4334.0	4335.8	4337.6	4339.4	4341.2	4343.0	4344.8	4346.6	4348.4	4350.2

For	°C	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
	°F	0.18	0.36	0.54	0.72	0.90	1.08	1.26	1.44	1.62	1.80

TEMPERATURES — CENTIGRADE TO FAHRENHEIT (Continued)

Conversion Table

For temperatures above 0° C.

Temp. °C.	0	1	2	3	4	5	6	7	8	9
2400	4352.0	4353.8	4355.6	4357.4	4359.2	4361.0	4362.8	4364.6	4366.4	4368.2
2410	4370.0	4371.8	4373.6	4375.4	4377.2	4379.0	4380.8	4382.6	4384.4	4386.2
2420	4388.0	4389.8	4391.6	4393.4	4395.2	4397.0	4398.8	4400.6	4402.4	4404.2
2430	4406.0	4407.8	4409.6	4411.4	4413.2	4415.0	4416.8	4418.6	4420.4	4422.2
2440	4424.0	4425.8	4427.6	4429.4	4431.2	4433.0	4434.8	4436.6	4438.4	4440.2
2450	4442.0	4443.8	4445.6	4447.4	4449.2	4451.0	4452.8	4454.6	4456.4	4458.2
2460	4460.0	4461.8	4463.6	4465.4	4467.2	4469.0	4470.8	4472.6	4474.4	4476.2
2470	4478.0	4479.8	4481.6	4483.4	4485.2	4487.0	4488.8	4490.6	4492.4	4494.2
2480	4496.0	4497.8	4499.6	4501.4	4503.2	4505.0	4506.8	4508.6	4510.4	4512.2
2490	4514.0	4515.8	4517.6	4519.4	4521.2	4523.0	4524.8	4526.6	4528.4	4530.2
2500	4532.0	4533.8	4535.6	4537.4	4539.2	4541.0	4542.8	4544.6	4546.4	4548.2
2510	4550.0	4551.8	4553.6	4555.4	4557.2	4559.0	4560.8	4562.6	4564.4	4566.2
2520	4568.0	4569.8	4571.6	4573.4	4575.2	4577.0	4578.8	4580.6	4582.4	4584.2
2530	4586.0	4587.8	4589.6	4591.4	4593.2	4595.0	4596.8	4598.6	4600.4	4602.2
2540	4604.0	4605.8	4607.6	4609.4	4611.2	4613.0	4614.8	4616.6	4618.4	4620.2
2550	4622.0	4623.8	4625.6	4627.4	4629.2	4631.0	4632.8	4634.6	4636.4	4638.2
2560	4640.0	4641.8	4643.6	4645.4	4647.2	4649.0	4650.8	4652.6	4654.4	4656.2
2570	4658.0	4659.8	4661.6	4663.4	4665.2	4667.0	4668.8	4670.6	4672.4	4674.2
2580	4676.0	4677.8	4679.6	4681.4	4683.2	4685.0	4686.8	4688.6	4690.4	4692.2
2590	4694.0	4695.8	4697.6	4699.4	4701.2	4703.0	4704.8	4706.6	4708.4	4710.2

TEMPERATURES — CENTIGRADE TO FAHRENHEIT (Continued)

Temp. °C	0	1	2	3	4	5	6	7	8	9
2600	4712.0	4713.8	4715.6	4717.4	4719.2	4721.0	4722.8	4724.6	4726.4	4728.2
2610	4730.0	4731.8	4733.6	4735.4	4737.2	4739.0	4740.8	4742.6	4744.4	4746.2
2620	4748.0	4749.8	4751.6	4753.4	4755.2	4757.0	4758.8	4760.6	4762.4	4764.2
2630	4766.0	4767.8	4769.6	4771.4	4773.2	4775.0	4776.8	4778.6	4780.4	4782.2
2640	4784.0	4785.8	4787.6	4789.4	4791.2	4793.0	4794.8	4796.6	4798.4	4800.2
2650	4802.0	4803.8	4805.6	4807.4	4809.2	4811.0	4812.8	4814.6	4816.4	4818.2
2660	4820.0	4821.8	4823.6	4825.4	4827.2	4829.0	4830.8	4832.6	4834.4	4836.2
2670	4838.0	4839.8	4841.6	4843.4	4845.2	4847.0	4848.8	4850.6	4852.4	4854.2
2680	4856.0	4857.8	4859.6	4861.4	4863.2	4865.0	4866.8	4868.6	4870.4	4872.2
2690	4874.0	4875.8	4877.6	4879.4	4881.2	4883.0	4884.8	4886.6	4888.4	4890.2
2700	4892.0	4893.8	4895.6	4897.4	4899.2	4901.0	4902.8	4904.6	4906.4	4908.2
2710	4910.0	4911.8	4913.6	4915.4	4917.2	4919.0	4920.8	4922.6	4924.4	4926.2
2720	4928.0	4929.8	4931.6	4933.4	4935.2	4937.0	4938.8	4940.6	4942.4	4944.2
2730	4946.0	4947.8	4949.6	4951.4	4953.2	4955.0	4956.8	4958.6	4960.4	4962.2
2740	4964.0	4965.8	4967.6	4969.4	4971.2	4973.0	4974.8	4976.6	4978.4	4980.2
2750	4982.0	4983.8	4985.6	4987.4	4989.2	4991.0	4992.8	4994.6	4996.4	4998.2
2760	5000.0	5001.8	5003.6	5005.4	5007.2	5009.0	5010.8	5012.6	5014.4	5016.2
2770	5018.0	5019.8	5021.6	5023.4	5025.2	5027.0	5028.8	5030.6	5032.4	5034.2
2780	5036.0	5037.8	5039.6	5041.4	5043.2	5045.0	5046.8	5048.6	5050.4	5052.2
2790	5054.0	5055.8	5057.6	5059.4	5061.2	5063.0	5064.8	5066.6	5068.4	5070.2

For	°C	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0

TEMPERATURES — CENTIGRADE TO FAHRENHEIT (Continued)

Conversion Table

For temperatures above 0° C.

Temp. °C.	0	1	2	3	4	5	6	7	8	9
2800	5072.0	5073.8	5075.6	5077.4	5079.2	5081.0	5082.8	5084.6	5086.4	5088.2
2810	5090.0	5091.8	5093.6	5095.4	5097.2	5099.0	5100.8	5102.6	5104.4	5106.2
2820	5108.0	5109.8	5111.6	5113.4	5115.2	5117.0	5118.8	5120.6	5122.4	5124.2
2830	5126.0	5127.8	5129.6	5131.4	5133.2	5135.0	5136.8	5138.6	5140.4	5142.2
2840	5144.0	5145.8	5147.6	5149.4	5151.2	5153.0	5154.8	5156.6	5158.4	5160.2
2850	5162.0	5163.8	5165.6	5167.4	5169.2	5171.0	5172.8	5174.6	5176.4	5178.2
2860	5180.0	5181.8	5183.6	5185.4	5187.2	5189.0	5190.8	5192.6	5194.4	5196.2
2870	5198.0	5199.8	5201.6	5203.4	5205.2	5207.0	5208.8	5210.6	5212.4	5214.2
2880	5216.0	5217.8	5219.6	5221.4	5223.2	5225.0	5226.8	5228.6	5230.4	5232.2
2890	5234.0	5235.8	5237.6	5239.4	5241.2	5243.0	5244.8	5246.6	5248.4	5250.2
2900	5252.0	5253.8	5255.6	5257.4	5259.2	5261.0	5262.8	5264.6	5266.4	5268.2
2910	5270.0	5271.8	5273.6	5275.4	5277.2	5279.0	5280.8	5282.6	5284.4	5286.2
2920	5288.0	5289.8	5291.6	5293.4	5295.2	5297.0	5298.8	5300.6	5302.4	5304.2
2930	5306.0	5307.8	5309.6	5311.4	5313.2	5315.0	5316.8	5318.6	5320.4	5322.2
2940	5324.0	5325.8	5327.6	5329.4	5331.2	5333.0	5334.8	5336.6	5338.4	5340.2
2950	5342.0	5343.8	5345.6	5347.4	5349.2	5351.0	5352.8	5354.6	5356.4	5358.2
2960	5360.0	5361.8	5363.6	5365.4	5367.2	5369.0	5370.8	5372.6	5374.4	5376.2
2970	5378.0	5379.8	5381.6	5383.4	5385.2	5387.0	5388.8	5390.6	5392.4	5394.2
2980	5396.0	5397.8	5399.6	5401.4	5403.2	5405.0	5406.8	5408.6	5410.4	5412.2
2990	5414.0	5415.8	5417.6	5419.4	5421.2	5423.0	5424.8	5426.6	5428.4	5430.2

TEMPERATURES — CENTIGRADE TO FAHRENHEIT (Concluded)

Temp. °C.	0	1	2	3	4	5	6	7	8	9
3000	5432.0	5433.8	5435.6	5437.4	5439.2	5441.0	5442.8	5444.6	5446.4	5448.2
3010	5450.0	5451.8	5453.6	5455.4	5457.2	5459.0	5460.8	5462.6	5464.4	5466.2
3020	5468.0	5469.8	5471.6	5473.4	5475.2	5477.0	5478.8	5480.6	5482.4	5484.2
3030	5486.0	5487.8	5489.6	5491.4	5493.2	5495.0	5496.8	5498.6	5500.4	5502.2
3040	5504.0	5505.8	5507.6	5509.4	5511.2	5513.0	5514.8	5516.6	5518.4	5520.2
3050	5522.0	5523.8	5525.6	5527.4	5529.2	5531.0	5532.8	5534.6	5536.4	5538.2
3060	5540.0	5541.8	5543.6	5545.4	5547.2	5549.0	5550.8	5552.6	5554.4	5556.2
3070	5558.0	5559.8	5561.6	5563.4	5565.2	5567.0	5568.8	5570.6	5572.4	5574.2
3080	5576.0	5577.8	5579.6	5581.4	5583.2	5585.0	5586.8	5588.6	5590.4	5592.2
3090	5594.0	5595.8	5597.6	5599.4	5601.2	5603.0	5604.8	5606.6	5608.4	5610.2

For interpolation										
°C	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
°F	0.18	0.36	0.54	0.72	0.90	1.08	1.26	1.44	1.62	1.80

TEMPERATURES — FAHRENHEIT TO CENTIGRADE

Conversion Table

The values in the body of the table give in degrees Centigrade the temperatures indicated in degrees Fahrenheit at the top and side.

$1° F. = 0.5556° C.$

Temperatures below 0° F.

Temp. ° F.	0	1	2	3	4	5	6	7	8	9
0	− 17.78	18.33	18.89	19.44	20.00	20.56	21.11	21.67	22.22	22.78
− 10	− 23.33	23.89	24.44	25.00	25.56	26.11	26.67	27.22	27.78	28.33
− 20	− 28.89	29.44	30.00	30.56	31.11	31.67	32.22	32.78	33.33	33.89
− 30	− 34.44	35.00	35.56	36.11	36.67	37.22	37.78	38.33	38.89	39.44
− 40	− 40.00	40.56	41.11	41.67	42.22	42.78	43.33	43.89	44.44	45.00
− 50	− 45.56	46.11	46.67	47.22	47.78	48.33	48.89	49.44	50.00	50.56
− 60	− 51.11	51.67	52.22	52.78	53.33	53.89	54.44	55.00	55.56	56.11
− 70	− 56.67	57.22	57.78	58.33	58.89	59.44	60.00	60.56	61.11	61.67
− 80	− 62.22	62.78	63.33	63.89	64.44	65.00	65.56	66.11	66.67	67.22
− 90	− 67.78	68.33	68.89	69.44	70.00	70.56	71.11	71.67	72.22	72.78

TEMPERATURES—FAHRENHEIT TO CENTIGRADE (Continued)

Temp. ° F.	0	1	2	3	4	5	6	7	8	9
−100	−73.33	73.89	74.44	75.00	75.56	76.11	76.67	77.22	77.78	78.33
−110	−78.89	79.44	80.00	80.56	81.11	81.67	82.22	82.78	83.33	83.89
−120	−84.44	85.00	85.56	86.11	86.67	87.22	87.78	88.33	88.89	89.44
−130	−90.00	90.56	91.11	91.67	92.22	92.78	93.33	93.89	94.44	95.00
−140	−95.56	96.11	96.67	97.22	97.78	98.33	98.89	99.44	100.00	100.56
−150	−101.11	101.67	102.22	102.78	103.33	103.89	104.44	105.00	105.56	106.11
−160	−106.67	107.22	107.78	108.33	108.89	109.44	110.00	110.56	111.11	111.67
−170	−112.22	112.78	113.33	113.89	114.44	115.00	115.56	116.11	116.67	117.22
−180	−117.78	118.33	118.89	119.44	120.00	120.56	121.11	121.67	122.22	122.76
−190	−123.33	123.89	124.44	125.00	125.56	126.11	126.67	127.22	127.78	128.33
−200	−128.89	129.44	130.00	130.56	131.11	131.67	132.22	132.78	133.33	133.89
−210	−134.44	135.00	135.56	136.11	136.67	137.22	137.78	138.33	138.89	139.44
−220	−140.00	140.56	141.11	141.67	142.22	142.78	143.33	143.89	144.44	145.00
−230	−145.56	146.11	146.67	147.22	147.78	148.33	148.89	149.44	150.00	150.56
−240	−151.11	151.67	152.22	152.78	153.33	153.89	154.44	155.00	155.56	156.11
−250	−156.67	157.22	157.78	158.33	158.89	159.44	160.00	160.56	161.11	161.67
−260	−162.22	163.78	163.33	163.89	164.44	165.00	165.56	166.11	166.67	167.22
−270	−167.78	168.33	168.89	169.44	170.00	170.56	171.11	171.67	172.22	172.78
−280	−173.33	173.89	174.44	175.00	175.56	176.11	176.67	177.22	177.78	178.33
−290	−178.89	179.44	180.00	180.56	181.11	181.67	182.22	182.78	183.33	183.89

For interpolation											
	°F	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
	°C	0.06	0.11	0.17	0.22	0.28	0.33	0.39	0.44	0.50	0.56

TEMPERATURES — FAHRENHEIT TO CENTIGRADE (Continued)

Conversion Tables

Temperature below 0° F.

Temp. ° F.	0	1	2	3	4	5	6	7	8	9
− 300	− 184.44	185.00	185.56	186.11	186.67	187.22	187.78	188.33	188.89	189.44
− 310	− 190.00	190.56	191.11	191.67	192.22	192.78	193.33	193.89	194.44	195.00
− 320	− 195.56	196.11	196.67	197.22	197.78	198.33	198.89	199.44	200.00	200.56
− 330	− 201.11	201.67	202.22	202.78	203.33	203.89	204.44	205.00	205.56	206.11
− 340	− 206.67	207.22	207.78	208.33	208.89	209.44	210.00	210.56	211.11	211.67
− 350	− 212.22	212.78	213.33	213.89	214.44	215.00	215.56	216.11	216.67	217.22
− 360	− 217.78	218.33	218.89	219.44	220.00	220.56	221.11	221.67	222.22	222.78
− 370	− 223.33	223.89	224.44	225.00	225.56	226.11	226.67	227.22	227.78	228.33
− 380	− 228.89	229.44	230.00	230.56	231.11	231.67	232.22	232.78	233.33	233.89
− 390	− 234.44	235.00	235.56	236.11	236.67	237.22	237.78	238.33	238.89	239.44
− 400	− 240.00	240.56	241.11	241.67	242.22	242.78	243.33	243.89	244.44	245.00
− 410	− 245.56	246.11	246.67	247.22	247.78	248.33	248.89	249.44	250.00	250.56
− 420	− 251.11	251.67	252.22	252.78	253.33	253.89	254.44	255.00	255.56	256.11
− 430	− 256.67	257.22	257.78	258.33	258.89	259.44	260.00	260.56	261.11	261.67
− 440	− 262.22	262.78	263.33	263.89	264.44	265.00	265.56	266.11	266.67	267.22
− 450	− 267.78	268.33	268.89	269.44	270.00	270.56	271.11	271.67	272.22	272.78

− 459.4° F. = − 273° C. = absolute zero.

TEMPERATURES—FAHRENHEIT TO CENTIGRADE (Continued)

Temperatures above 0° F.

Temp. °F	0	1	2	3	4	5	6	7	8	9
0	− 17.78	17.22	16.67	16.11	15.56	15.00	14.44	13.89	13.33	12.78
+ 10	− 12.22	11.67	11.11	10.56	10.00	9.44	8.89	8.33	7.78	7.22
20	− 6.67	6.11	5.56	5.00	4.44	3.89	3.33	2.78	2.22	1.67
30	− 1.11	− 0.56	0.00	+ 0.56	+ 1.11	+ 1.67	+ 2.22	+ 2.78	+ 3.33	+ 3.89
40	+ 4.44	5.00	5.56	6.11	6.67	7.22	7.78	8.33	8.89	9.44
50	10.00	10.56	11.11	11.67	12.22	12.78	13.33	13.89	14.44	15.00
60	15.56	16.11	16.67	17.22	17.78	18.33	18.89	19.44	20.00	20.56
70	21.11	21.67	22.22	22.78	23.33	23.89	24.44	25.00	25.56	26.11
80	26.67	27.22	27.78	28.33	28.89	29.44	30.00	30.56	31.11	31.67
90	32.22	32.78	33.33	33.89	34.44	35.00	35.56	36.11	36.67	37.22
100	37.78	38.33	38.89	39.44	40.00	40.56	41.11	41.67	42.22	42.78
110	43.33	43.89	44.44	45.00	45.56	46.11	46.67	47.22	47.78	48.33
120	48.89	49.44	50.00	50.56	51.11	51.67	52.22	52.78	53.33	53.89
130	54.44	55.00	55.56	56.11	56.67	57.22	57.78	58.33	58.89	59.44
140	60.00	60.56	61.11	61.67	62.22	62.78	63.33	63.89	64.44	65.00
150	65.56	66.11	66.67	67.22	67.78	68.33	68.89	69.44	70.00	70.56
160	71.11	71.67	72.22	72.78	73.33	73.89	74.44	75.00	75.56	76.11
170	76.67	77.22	77.78	78.33	78.89	79.44	80.00	80.56	81.11	81.67
180	82.22	82.78	83.33	83.89	84.44	85.00	85.56	86.11	86.67	87.22
190	87.78	88.33	88.89	89.44	90.00	90.56	91.11	91.67	92.22	92.78

For interpolation											
	°F	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
	°C	0.06	0.11	0.17	0.22	0.28	0.33	0.39	0.44	0.50	0.56

TEMPERATURES — FAHRENHEIT TO CENTIGRADE (Continued)

Conversion Tables

Temperatures above 0° F.

Temp. °F.	0	1	2	3	4	5	6	7	8	9
200	93.33	93.89	94.44	95.00	95.56	96.11	96.67	97.22	97.78	98.33
210	98.89	99.44	100.00	100.56	101.11	101.67	102.22	102.78	103.33	103.89
220	104.44	105.00	105.56	106.11	106.67	107.22	107.78	108.33	108.89	109.44
230	110.00	110.56	111.11	111.67	112.22	112.78	113.33	113.89	114.44	115.00
240	115.56	116.11	116.67	117.22	117.78	118.33	118.89	119.44	120.00	120.56
250	121.11	121.67	122.22	122.78	123.33	123.89	124.44	125.00	125.56	126.11
260	126.67	127.22	127.78	128.33	128.89	129.44	130.00	130.56	131.11	131.67
270	132.22	132.78	133.33	133.89	134.44	135.00	135.56	136.11	136.67	137.22
280	137.78	138.33	138.89	139.44	140.00	140.56	141.11	141.67	142.22	142.78
290	143.33	143.89	144.44	145.00	145.56	146.11	146.67	147.22	147.78	148.33
300	148.89	149.44	150.00	150.56	151.11	151.67	152.22	152.78	153.33	153.89
310	154.44	155.00	155.56	156.11	156.67	157.22	157.78	158.33	158.89	159.44
320	160.00	160.56	161.11	161.67	162.22	162.78	163.33	163.89	164.44	165.00
330	165.56	166.11	166.67	167.22	167.78	168.33	168.89	169.44	170.00	170.56
340	171.11	171.67	172.22	172.78	173.33	173.89	174.44	175.00	175.56	176.11
350	176.67	177.22	177.78	178.33	178.89	179.44	180.00	180.56	181.11	181.67
360	182.22	182.78	183.33	183.89	184.44	185.00	185.56	186.11	186.67	187.22
370	187.78	188.33	188.89	189.44	190.00	190.56	191.11	191.67	192.22	192.78
380	193.33	193.89	194.44	105.00	195.56	196.11	196.67	197.22	197.78	198.33
390	198.89	199.44	200.00	200.56	201.11	201.67	202.22	202.78	203.33	203.89

TEMPERATURES—FAHRENHEIT TO CENTIGRADE (Continued)

Temp. °F.	0	1	2	3	4	5	6	7	8	9
400	204.44	205.00	205.56	206.11	206.67	207.22	207.78	208.33	208.89	209.44
410	210.00	210.56	211.11	211.67	212.22	212.78	213.33	213.89	214.44	215.00
420	215.56	216.11	216.67	217.22	217.78	218.33	218.89	219.44	220.00	220.56
430	221.11	221.67	222.22	222.78	223.33	223.89	224.44	225.00	225.56	226.11
440	226.67	227.22	227.78	228.33	228.89	229.44	230.00	230.56	231.11	231.67
450	232.22	232.78	233.33	233.89	234.44	235.00	235.56	236.11	236.67	237.22
460	237.78	238.33	238.89	239.44	240.00	240.56	241.11	241.67	242.22	242.78
470	243.33	243.89	244.44	245.00	245.56	246.11	246.67	247.22	247.78	248.33
480	248.89	249.44	250.00	250.56	251.11	251.67	252.22	252.78	253.33	253.89
490	254.44	255.00	255.56	256.11	256.67	257.22	257.78	258.33	258.89	259.44
500	260.00	260.56	261.11	261.67	262.22	262.78	263.33	263.89	264.44	265.00
510	265.56	266.11	266.67	267.22	267.78	268.33	268.89	269.44	270.00	270.56
520	271.11	271.67	272.22	272.78	273.33	273.89	274.44	275.00	275.56	276.11
530	276.67	277.22	277.78	278.33	278.89	279.44	280.00	280.56	281.11	281.67
540	282.22	282.78	283.33	283.89	284.44	285.00	285.56	286.11	286.67	287.22
550	287.78	288.33	288.89	289.44	290.00	290.56	291.11	291.67	292.22	292.78
560	293.33	293.89	294.44	295.00	295.56	296.11	296.67	297.22	297.78	298.33
570	298.89	299.44	300.00	300.56	301.11	301.67	302.22	302.78	303.33	303.89
580	304.44	305.00	305.56	306.11	306.67	307.22	307.78	308.33	308.89	309.44
590	310.00	310.56	311.11	311.67	312.22	312.78	313.33	313.89	314.44	315.00

For interpolation											
	°F	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
	°C	0.06	0.11	0.17	0.22	0.28	0.33	0.39	0.44	0.50	0.56

TEMPERATURES — FAHRENHEIT TO CENTIGRADE (Continued)

Conversion Tables

Temperatures above 0° F.

Temp. °F.	0	1	2	3	4	5	6	7	8	9
600	315.56	316.11	316.67	317.22	317.78	318.33	318.89	319.44	320.00	320.56
610	321.11	321.67	322.22	322.78	323.33	323.89	324.44	325.00	325.56	326.11
620	326.67	327.22	327.78	328.33	328.89	329.44	330.00	330.56	331.11	331.67
630	332.22	332.78	333.33	333.89	334.44	335.00	335.56	356.11	336.67	337.22
640	337.78	338.33	338.89	339.44	340.00	340.56	341.11	341.67	342.22	342.78
650	343.33	343.89	344.44	345.00	345.56	346.11	346.67	347.22	347.78	348.33
660	348.89	349.44	350.00	350.56	351.11	351.67	352.22	352.78	353.33	353.89
670	354.44	355.00	355.56	356.11	356.67	357.22	357.78	358.33	358.89	359.44
680	360.00	360.56	361.11	361.67	362.22	362.78	363.33	363.89	364.44	365.00
690	365.56	366.11	366.67	367.22	367.78	368.33	368.89	369.44	370.00	370.56
700	371.11	371.67	372.22	372.78	373.33	373.89	374.44	375.00	375.56	376.11
710	376.67	377.22	377.78	378.33	378.89	379.44	380.00	380.56	381.11	381.67
720	382.22	382.78	383.33	383.89	384.44	385.00	385.56	386.11	386.67	387.22
730	387.78	388.33	388.89	389.44	390.00	390.56	391.11	391.67	392.22	392.78
740	393.33	393.89	394.44	395.00	395.56	396.11	396.67	397.22	397.78	398.33
750	398.89	399.44	400.00	400.56	401.11	401.67	402.22	402.78	403.33	403.89
760	404.44	405.00	405.56	406.11	406.67	407.22	407.78	408.33	408.89	409.44
770	410.00	410.56	411.11	411.67	412.22	412.78	413.33	413.89	414.44	415.00
780	415.56	416.11	416.67	417.22	417.78	418.33	418.89	419.44	420.00	420.56
790	421.11	421.67	422.22	422.78	423.33	423.89	424.44	425.00	425.56	426.11

TEMPERATURES — FAHRENHEIT TO CENTIGRADE (Concluded)

Temp. 0° F.	0	1	2	3	4	5	6	7	8	9
800	426.67	427.22	427.78	428.33	428.89	429.44	430.00	430.56	431.11	431.67
810	432.22	432.78	433.33	433.89	434.44	435.00	435.56	436.11	436.67	437.22
820	437.78	438.33	438.89	439.44	440.00	440.56	441.11	441.67	442.22	442.78
830	443.33	443.89	444.44	445.00	445.56	446.11	446.67	447.22	447.78	448.33
840	448.89	449.44	450.00	450.56	451.11	451.67	452.22	452.78	453.33	453.89
850	454.44	455.00	455.56	456.11	456.67	457.22	457.78	458.33	458.89	459.44
860	460.00	460.56	461.11	461.67	462.22	462.78	463.33	463.89	464.44	465.00
870	465.56	466.11	466.67	467.22	467.78	468.33	468.89	469.44	470.00	470.56
880	471.11	471.67	472.22	472.78	473.33	473.89	474.44	475.00	475.56	476.11
890	476.67	477.22	477.78	478.33	478.89	479.44	480.00	480.56	481.11	481.67
900	482.22	482.78	483.33	483.89	484.44	485.00	485.56	486.11	486.67	487.22
910	487.78	488.33	488.89	489.44	490.00	490.56	491.11	491.67	492.22	492.78
920	493.33	493.89	494.44	495.00	495.56	496.11	496.67	497.22	497.78	498.33
930	498.89	499.44	500.00	500.56	501.11	501.67	502.22	502.78	503.33	503.89
940	504.44	505.00	505.56	506.11	506.67	507.22	507.78	508.33	508.89	509.44
950	510.00	510.56	511.11	511.67	512.22	512.78	513.33	513.89	514.44	515.00
960	515.56	516.11	516.67	517.22	517.78	518.33	518.89	519.44	520.00	520.56
970	521.11	521.67	522.22	522.78	523.33	523.89	524.44	525.00	525.56	526.11
980	526.67	527.22	527.78	523.33	528.89	529.44	530.00	530.56	531.11	531.67
990	532.22	532.78	533.33	533.89	534.44	535.00	535.56	536.11	536.67	537.22

For interpolation											
	°F	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	0.10
	°C	0.06	0.11	0.17	0.22	0.28	0.33	0.39	0.44	0.50	0.56

WIRE TABLES

COMPARISON OF WIRE GAUGES

DIAMETER OF WIRE IN INCHES

Gauge No.	Brown & Sharpe.	Birmingham or Stub's.	Washburn & Moen.	Imperial or Brit. Std.	Stub's Steel.	U. S. Std. plate.	Music wire.
00000000	.....	....	....	....	..	.....	.008
0000000	.....	....	....	.500	..	.....	.007
000000	.....	....	....	.464	..	.46875	.009
00000	.....	....	....	.432	..	.4375	.010
0000	.4600	.454	.3938	.400	..	.40625	.011
000	.4096	.425	.3625	.372	..	.375	.012
00	.3648	.380	.3310	.348	..	.34375	.013
0	.3249	.340	.3065	.324	..	.3125	.014
1	.2893	.300	.2830	.300	.227	.28125	.015
2	.2576	.284	.2625	.276	.219	.265625	.016
3	.2294	.259	.2437	.252	.212	.25	.017
4	.2043	.238	.2253	.232	.207	.234375	.018
5	.1819	.220	.2070	.212	.204	.21875	.020
6	.1620	.203	.1920	.192	.201	.203125	.021
7	.1443	.180	.1770	.176	.199	.1875	.023
8	.1285	.165	.1620	.160	.197	.171875	.024
9	.1144	.148	.1483	.144	.194	.15625	.025
10	.1019	.134	.1350	.128	.191	.140625	.027
11	.09074	.120	.1205	.116	.188	.125	.028
12	.08081	.109	.1055	.104	.185	.109375	.029
13	.07196	.095	.0915	.092	.182	.09375	.031
14	.06408	.083	.0800	.080	.180	.078125	.032
15	.05707	.072	.0720	.072	.178	.0703125	.034
16	.05082	.065	.0625	.064	.175	.0625	.036
17	.04526	.058	.0540	.056	.172	.05625	.037
18	.04030	.049	.0475	.048	.168	.05	.039
19	.03589	.042	.0410	.040	.164	.04375	.041
20	.03196	.035	.0348	.036	.161	.0375	.043
21	.02846	.032	.0318	.032	.157	.034375	.046
22	.02535	.028	.0286	.028	.155	.03125	.048
23	.02257	.025	.0258	.024	.153	.028125	.051
24	.02010	.022	.0230	.022	.151	.025	.055

COMPARISON OF WIRE GAUGES (Continued)

DIAMETER OF WIRE IN INCHES

Gauge No.	Brown & Sharpe.	Birmingham or Stub's.	Washburn & Moen.	Imperial or Brit. Std.	Stub's steel.	U. S. Std. plate.	Music wire.
25	.01790	.020	.0204	.020	.148	.021875	.0586
26	.01594	.018	.0181	.018	.146	.01875	.0626
27	.01419	.016	.0173	.0164	.143	.0171875	.0658
28	.01264	.014	.0162	.0149	.139	.015625	.0720
29	.01126	.013	.0150	.0136	.134	.0140625	.0760
30	.01003	.012	.0140	.0124	.127	.0125	.0800
31	.008928	.010	.0132	.0116	.120	.0109375	.0820
32	.007950	.009	.0128	.0108	.115	.01015625	.0860
33	.007080	.008	.0118	.0100	.112	.009375	.0900
34	.006304	.007	.0104	.0092	.110	.00859375	.0950
35	.005614	.005	.0095	.0084	.108	.0078125	
36	.005000	.004	.0090	.0076	.106	.00703125	
37	.004453	....	....	.0068	.103	.006640625	
38	.003965	....	....	.0060	.101	.00625	
39	.003531	....	....	.0052	.099		
40	.003145	....	....	.0048	.097		

TWIST DRILL AND STEEL WIRE GAUGE

INCHES

No.	Size.	No.	Size.	No.	Size.	No.	Size.	No.	Size.	No.	Size.
1	.2280	11	.1910	21	.1590	31	.1200	41	.0960	51	.0670
2	.2210	12	.1890	22	.1570	32	.1160	42	.0935	52	.0635
3	.2130	13	.1850	23	.1540	33	.1130	43	.0890	53	.0595
4	.2090	14	.1820	24	.1520	34	.1110	44	.0860	54	.0550
5	.2055	15	.1800	25	.1495	35	.1100	45	.0820	55	.0520
6	.2040	16	.1770	26	.1470	36	.1065	46	.0810	56	.0465
7	.2010	17	.1730	27	.1440	37	.1040	47	.0785	57	.0430
8	.1990	18	.1695	28	.1405	38	.1015	48	.0760	58	.0420
9	.1960	19	.1660	29	.1360	39	.0995	49	.0730	59	.0410
10	.1935	20	.1610	30	.1285	40	.0980	50	.0700	60	.0400

DIMENSIONS OF WIRE

Stub's Gauge

Giving the diameter and cross-section in English and metric system for the Birmingham or Stub's gauge.

Gauge No.	Diameter in ins.	Section in sq.ins.	Diameter in cms.	Section in sq.cms.
0000	0.454	0.16188	1.1532	1.0444
000	.425	.14186	.0795	0.9152
00	.380	.11341	0.9652	.7317
0	.340	.09079	.8636	.5858
1	0.300	0.07069	0.7620	0.4560
2	.284	.06335	.7214	.4087
3	.259	.05269	.6579	.3399
4	.238	.04449	.6045	.2870
5	.220	.03801	.5588	.2452
6	0.203	0.03237	0.5156	0.20881
7	.180	.02545	.4572	.16147
8	.165	.02138	.4191	.13795
9	.148	.01720	.3759	.11099
10	.134	.01410	.3404	.09098
11	0.120	0.011310	0.3048	0.07297
12	.109	.009331	.2769	.06160
13	.095	.007088	.2413	.04573
14	.083	.005411	.2108	.03491
15	.072	.004072	.1829	.02627
16	0.065	0.0033183	0.16510	0.021409
17	.058	.0026421	.14732	.017046
18	.049	.0018857	.12446	.012166
19	.042	.0013854	.10668	.008938
20	.035	.0009621	.08890	.006207
21	0.032	0.0008042	0.08128	0.005189
22	.028	.0006158	.07112	.003973
23	.025	.0004909	.06350	.003167
24	.022	.0003801	.05588	.002452
25	.020	.0003142	.05080	.002027
26	0.018	0.0002545	0.04572	0.0016417
27	.016	.0002011	.04064	.0012972
28	.014	.0001539	.03556	.0009932
29	.013	.0001327	.03302	.0008563
30	.012	.0001181	.03048	.0007297
31	0.010	0.00007854	0.02540	0.0005067
32	.009	.00006362	.02286	.0004104
33	.008	.00005027	.02032	.0003243
34	.007	.00003848	.01778	.0002483
35	.005	.00001963	.01270	.0001267
36	0.004	0.00001257	0.01016	0.0000811

DIMENSIONS OF WIRE (Continued)

British Standard Gauge

Giving the diameter and cross-section in English and metric system for the British Standard Gauge.

Gauge No.	Diameter in ins.	Section in sq.ins.	Diameter in cms.	Section in sq.cms.
7-0	0.500	0.1963	1.2700	1.267
6-0	.464	.1691	1.1786	1.091
5-0	0.432	0.1466	1.0973	0.9456
4-0	.400	.1257	1.0160	.8107
3-0	.372	.1087	0.9449	.7012
2-0	.348	.0951	.8839	.6136
0	.324	.0825	.8230	.5319
1	0.300	0.07069	0.7620	0.4560
2	.276	.05983	.7010	.3858
3	.252	.04988	.6401	.3218
4	.232	.04227	.5893	.2727
5	.212	.03530	.5385	.2277
6	0.192	0.02895	0.4877	0.18679
7	.176	.02433	.4470	.15696
8	.160	.02010	.4064	.12973
9	.144	.01629	.3658	.10507
10	.128	.01287	.3251	.08302
11	0.116	0.010568	0.2946	0.06818
12	.104	.008495	.2642	.05480
13	.092	.006648	.2337	.04289
14	.080	.005027	.2032	.03243
15	.072	.004071	.1829	.02627
16	0.064	0.003217	0.16256	0 020755
17	.056	.002463	.14224	.015890
18	.048	.001810	.12192	.011675
19	.040	.001257	.10160	.008107
20	.036	.001018	.09144	.006567
21	0.032	0.0008042	0.08128	0.005189
22	.028	.0006158	.07112	.003973
23	.024	.0004524	.06096	.002922
24	.022	.0003801	.05588	.002452
25	.020	.0003142	.05080	.002027
26	0.0180	0 0002545	0.04572	0.0016417
27	.0164	.0002112	.04166	.0013628
28	.0148	.0001728	.03759	.0011099
29	.0136	.0001453	.03454	.0009363
30	.0124	.0001208	.03150	.0007791
31	0 0116	0 .00010568	0.02946	0.0006818
32	.0108	.00009161	.02743	.0005910
33	.0100	.00007854	.02540	.0005067
34	.0092	.00006648	.02337	.0004289
35	.0084	.00005542	.02134	.0003575
36	0.0076	0.00004536	0.01930	0.0002927
37	.0068	.00003632	.01727	.0002343
38	.0060	.00002827	.01524	.0001824
39	.0052	.00002124	.01321	.0001370
40	.0048	.00001810	.01219	.0001167
41	0.0044	0.00001521	0.01118	0.0000982
42	.0040	.00001257	.01016	.0000811
43	.0036	.00001018	.00914	.0000656
44	.0032	.00000804	.00813	.0000519
45	.0028	.00000616	.00711	.0000397
46	0.0024	0.00000452	0.00610	0.0000212
47	.0020	.00000314	.00508	.0000203
48	.0016	.00000201	.00406	.0000129
49	.0012	.00000113	.00305	.0000073
50	.0010	.00000079	.00254	.0000051

PLATINUM WIRE TABLE, BROWN & SHARPE GAUGE

GIVING DIAMETER AND APPROXIMATE MASS

GAUGE No.	10	11	12	13	14	15	16
Diameter in dec. in....	0.106	0.091	0.081	0.072	0.064	0.057	0.051
Approximate mass in grams, per foot.....	37.5	28.0	22.0	17.5	14.0	11.0	9.0
GAUGE No.	17	18	19	20	21	22	
Diameter in dec. in...	0.045	0.041	0.036	0.032	0.029	0.026	
Approximate mass in grams, per foot.....	7.0	5.7	4.4	3.4	2.9	2.3	
GAUGE No.	23	24	25	26	27	28	
Diameter in dec. in...	0.023	0.020	0.018	0.016	0.014	0.013	
Approximate mass in in grams, per foot...	1.8	1.4	1.1	0.9	0.7	0.6	
GAUGE No.	29	30	31	32	33	34	35
Diameter in dec. in...	0.0115	0.010	0.009	0.008	0.007	0.0063	0.0056
Approximate mass in in grams, per foot...	0.45	0.35	0.28	0.22	0.17	0.15	0.11

RESISTANCE OF ALUMINUM WIRE

GIVING THE RESISTANCE OF HARD DRAWN ALUMINUM WIRE AT 20° C.

(From the Bureau of Standards.)

Gauge number.	Ohms per 1000 ft.	Ohms per kilometer.	Gauge number.	Ohms per 1000 ft.	Ohms per kilometer.
0000	0.0804	0.264	20	16.7	54.6
000	.101	.333	21	21.0	68.9
00	.128	.419	22	26.5	86.9
0	.161	.529	23	33.4	110.
1	.203	.667	24	42.1	138.
2	.256	.841	25	53.1	174.
3	.323	1.06	26	67.0	220.
4	.408	1.34	27	84.4	277.
5	.514	1.69	28	106.	349.
6	.648	2.13	29	134.	440.
7	.817	2.68	30	169.	555.
8	1.03	3.38	31	213.	700.
9	1.30	4.26	32	269.	883.
10	1.64	5.38	33	339.	1110.
11	2.07	6.78	34	428.	1400.
12	2.61	8.55	35	540.	1770.
13	3.29	10.8	36	681.	2230.
14	4.14	13.6	37	858.	2820.
15	5.22	17.1	38	1080.	3550.
16	6.59	21.6	39	1360.	4480.
17	8.31	27.3	40	1720.	5640.
18	10.5	34.4			
19	13.2	43.3			

DIMENSIONS OF WIRE, B. & S. GAUGE, U. S.

Diameter and cross-section of wires, Brown & Sharpe Gauge, mass of pure hard-drawn copper wire at 32° F. (density 8.90).

Gauge number.	Diam. in ins.	Cross-section in sq.in.	Pounds per ft.	Feet per lb.
0000	0.4600	0.1662	0.6412	1.560
000	.4096	.1318	.5085	1.967
00	.3648	.1045	.4033	2.480
0	.3249	.0829	.3198	3.127
1	0.2893	0.06573	0.2536	3.943
2	.2576	.05213	.2011	4.972
3	.2294	.04134	.1595	6.270
4	.2043	.03278	.1265	7.905
5	.1819	.02600	.1003	9.969
6	0.1620	0.02062	0.07955	12.57
7	.1443	.01635	.06309	15.85
8	.1285	.01297	.05003	19.99
9	.1144	.01028	.03968	25.20
10	.1019	.00815	.03146	31.78
11	0.09074	0.006467	0.02495	40.08
12	.08081	.005129	.01979	50.54
13	.07196	.004067	.01569	63.72
14	.06408	.003225	.01244	80.35
15	.05707	.002558	.00987	101.32
16	0.05082	0.002028	0.007827	127.8
17	.04526	.001609	.006207	161.1
18	.04030	.001276	.004922	203.2
19	.03589	.001012	.003904	256.2
20	.03196	.000802	.003096	323.1
21	0.02846	0.0006363	0.002455	408.2
22	.02535	.0005046	.001947	513.6
23	.02257	.0004001	.001544	647.7
24	.02010	.0003173	.001224	816.7
25	.01790	.0002517	.000971	1029.9
26	0.01594	0.0001996	0.0007700	1298.
27	.01419	.0001583	.0006107	1638.
28	.01264	.0001255	.0004843	2065.
29	.01126	.0000995	.0003841	2604.
30	.01003	.0000789	.0003046	3283.
31	0.008928	0.00006260	0.0002415	4140.
32	.007950	.00004964	.0001915	5221.
33	.007080	.00003937	.0001519	6583.
34	.006304	.00003122	.0001205	8301.
35	.005614	.00002476	.0000955	10468.
36	0.005000	0.00001963	0.00007576	13200.
37	.004453	.00001557	.00006008	16644.
38	.003965	.00001235	.00004765	20988.
39	.003531	.00000979	.00003778	26465.
40	.003145	.00000777	.00002996	33372.

MASS AND RESISTANCE FOR COPPER

Measure

Electrical resistance of pure hard-drawn copper wire at 32° F (density 8.90.)

Gauge number.	Ohms per ft.	Ft. per ohm.	Ohms per lb.	Lbs. per ohm.
0000	0.00004629	21601.	0.00007219	13852.
000	.00005837	17131.	.00011479	8712.
00	.00007361	13586.	.00018253	5479.
0	.00009282	10774.	.00029023	3445.
.1	0.0001170	8544.	0.0004615	2166.8
.2	.0001476	6775.	.0007338	1362.8
.3	.0001861	5373.	.0011668	857.0
.4	.0002347	4261.	.0018552	539.0
.5	.0002959	3379.	.0029499	339.0
.6	0.0003731	2680.	0.004690	213.22
7	.0004705	2125.	.007458	134.08
.8	.0005933	1685.	.011859	84.32
.9	.0007482	1337.	.018857	53.03
10	.0009434	1060.	.029984	33.35
11	0.001190	840.6	0.04768	20.973
12	.001500	666.6	.07581	13.191
13	.001892	528.7	.12054	8.296
14	.002385	419.2	.19166	5.218
15	.003008	332.5	.30476	3.281
16	0.003793	263.7	0.4846	2.0636
17	.004783	209.1	.7705	1.2979
18	.006031	165.8	1.2252	0.8162
19	.007604	131.5	1.9481	.5133
20	.009589	104.3	3.0976	.3228
21	0.01209	82.70	4.925	0.20305
22	.01525	65.59	7.832	.12768
23	.01923	52.01	12.453	.08030
24	.02424	41.25	19.801	.05051
25	.03057	32.71	31.484	.03176
26	0.03855	25.94	50.06	0.019976
27	.04861	20 57	79.60	.012563
28	.06130	16.31	126.57	.007901
29	.07729	12.94	201.26	.004969
30	.09746	10.26	320.01	.003125
31	0.1229	8.137	508.8	0.0019654
32	.1550	6.452	809.1	.0012359
33	.1954	5.117	1286.5	.0007773
34	.2464	4.058	2045.6	.0004889
35	.3107	3.218	3252.6	.0003074
36	0.3918	2.552	5172.	0.0001934
37	.4941	2.024	8224.	.0001216
38	.6230	1.605	13076.	.0000765
39	.7856	1.273	20792.	.0000481
40	.9906	1.009	33060.	.0000303

DIMENSIONS OF WIRE B. & S. GAUGE,

Metric

Diameter, cross-section of wires, Brown & Sharpe gauge, mass of pure hard-drawn copper wire at 0° C. (density 8.90).

Gauge number.	Diam. in cm.	Cross-section in sq.cm.	Grams per meter.	Meters per gram.
0000	1.1684	1.0722	954.3	0.001048
000	.0405	0.8503	756.8	.001322
00	0.9266	.7643	600.1	.001666
0	.8251	.5348	475.9	.002101
1	0.7348	0.4241	377.4	0.002649
2	.6544	.3363	299.3	.003341
3	.5827	.2667	237.4	.004213
4	.5189	.2115	188.2	.005312
5	.4621	.1677	149.3	.006699
6	0.4115	0.13302	118.39	0.00845
7	.3665	.10549	93.88	.01065
8	.3264	.08366	74.45	.01343
9	.2906	.06634	59.04	.01694
10	.2588	.05261	46.82	.02136
11	0.2305	0.04172	37.13	0.02693
12	.2053	.03309	29.45	.03396
13	.1828	.02624	23.35	.04282
14	.1628	.02081	18.52	.05400
15	.1450	.01650	14.69	.06809
16	0.12908	0.013087	11.648	0.0859
17	.11495	.010378	9.237	.1083
18	.10237	.008231	7.325	.1365
19	.09116	.006527	5.809	.1721
20	.08118	.005176	4.607	.2171
21	0.07229	0.004105	3.653	0.2737
22	.06438	.003255	2.898	.3450
23	.05733	.002582	2.298	.4352
24	.05106	.002047	1.822	.5488
25	.04545	.001624	1.445	.6920
26	0.04049	0.0012876	1.1459	0.873
27	.03606	.0010211	.9088	1.100
28	.03211	.0008098	.7207	1.388
29	.02859	.0006422	.5715	1.750
30	.02546	.0005093	.4532	2.206
31	0.02268	0.0004039	0.3594	2.782
32	.02019	.0003203	.2850	3.508
33	.01798	.0002540	.2261	4.424
34	.01601	.0002014	.1793	5.578
35	.01426	.0001597	.1422	7.034
36	0.01270	0.0001267	0.1127	8.87
37	.01131	.0001005	.0894	11.18
38	.01007	.0000797	.0709	14.10
39	.00897	.0000632	.0562	17.78
40	.00799	.0000501	.0446	22.43

MASS AND RESISTANCE FOR COPPER (Continued)

System

Electrical resistance of pure hard-drawn copper wire at 0° C. (density 8.90).

Gauge number.	Ohms per meter.	Meters per ohm.	Ohms per gram.	Grams per ohm.
0000	0.0001519	6584.	0.0000001592	6283000.
000	.0001915	5221.	.0000002531	3951000.
00	.0002415	4141.	.0000004024	2485000.
0	.0003045	3284.	.0000006398	1563000.
1	0.0003840	2604.	0.000001017	928900.
2	.0004842	2065.	.000001618	618200.
3	.0006106	1638.	.000002572	388800.
4	.0007699	1299.	.000004090	244500.
5	.0009709	1030.	.000006504	153800.
6	0.001224	816.9	0.00001034	96700.
7	.001544	647.8	.00001644	60820.
8	.001947	513.7	.00002615	38250.
9	.002455	407.4	.00004157	24050.
10	.003095	323.1	.00006610	15130.
11	0.003903	256.2	0.00010511	9514.
12	.004922	203.2	.00016712	5984.
13	.006206	161.1	.00026574	3763.
14	.007826	127.8	.00042254	2367.
15	.009868	101.3	.00067187	1488.
16	0.01244	80.37	0.0010683	936.1
17	.01569	63.73	.0016987	588.7
18	.01979	50.54	.0027010	370.2
19	.02495	40.08	.0042948	232.8
20	.03146	31.79	.0068290	146.4
21	0.03967	25.21	0.010859	92.09
22	.05002	19.99	.017266	57.92
23	.06308	15.85	.027454	36.42
24	.07954	12.57	.043653	22.91
25	.10030	9.97	.069411	11.88
26	0.12647	7.907	0.11037	9.060
27	.15948	6.270	.17549	5.698
28	.20110	4.973	.27904	3.584
29	.25358	3.943	.44369	2.254
30	.31976	3.127	.70550	1.417
31	0.4032	2.480	1.1218	0.8914
32	.5084	1.967	1.7837	.5606
33	.6411	1.560	2.8362	.3526
34	.8085	1.237	4.5097	.2217
35	1.0194	0.981	7.1708	.1394
36	1.2855	0.7779	11.376	0.08790
37	1.6210	.6169	18.130	.05516
38	2.0440	.4892	28.828	.03469
39	2.5775	.3880	45.838	.02182
40	3.2501	.3076	72.885	.01372

CROSS-SECTION AND MASS OF WIRES

U. S. Measure

Diameters are given in mils (1 mil = .001 in.), and area in square mils (1 sq. mil = .000001 sq.in.). For sections and masses for one-tenth the diameters given, divide by 100 and for sections and masses for ten times the diameter multiply by 100.

Diam. in mils.	Cross-sec. in sq. mils.	Pounds per foot.			
		Copper, density 8.90.	Iron, density 7.80.	Brass, density 8.56.	Aluminum, density 2.67.
10	78.54	0.000303	0.0002656	0.0002915	0.0000909
11	95.03	0367	03214	03527	01100
12	113.10	0436	03825	04197	01309
13	132.73	0512	04488	04926	01536
14	153.94	0594	05206	05713	01782
15	176.71	0.000682	0.0005976	0.0006558	0.0002045
16	201.06	0776	06799	07461	02327
17	226.98	0876	07675	08423	02627
18	254.47	0982	08605	09443	02946
19	283.53	1094	09588	10522	03282
20	314.16	0.001212	0.001062	0.001166	0.0003636
21	346.36	1336	1171	1285	04009
22	380.13	1467	1286	1411	04400
23	415.48	1603	1405	1542	04809
24	452.39	1746	1530	1679	05237
25	490.87	0.001894	0.001660	0.001822	0.0005682
26	530.93	2046	1795	1970	06147
27	572.56	2209	1936	2125	06628
28	615.75	2376	2082	2285	07127
29	660.52	2549	2234	2451	07646
30	706.86	0.002727	0.002390	0.002623	0.0008182
31	754.77	2912	2552	2801	08737
32	804.25	3103	2720	2985	09309
33	855.30	3300	2892	3174	09900
34	907.92	3503	3070	3369	10509
35	962.11	0.003712	0.003253	0.003570	0.001114
36	1017.88	3927	3442	3777	1178
37	1075.21	4149	3636	3990	1245
38	1134.11	4376	3844	4218	1316
39	1194.59	4609	4040	4433	1383
40	1256.64	0.004849	0.004249	0.004664	0.001455
41	1320.25	5094	4465	4900	1528
42	1385.44	5346	4685	5141	1604
43	1452.20	5603	4911	5389	1681
44	1520.53	5867	5142	5643	1760
45	1590.43	0.006137	0.005378	0.005902	0.001841
46	1661.90	6412	5620	6167	1924
47	1734.94	6694	5867	6438	2008
48	1809.56	6982	6119	6715	2095
49	1885.74	7276	6377	6998	2183
50	1963.50	0.007576	0.006640	0.007287	0.002273
51	2042.82	7882	6908	7581	2365
52	2123.72	8194	7181	7881	2458
53	2206.18	8512	7460	8187	2554
54	2290.22	8837	7744	8499	2651

CROSS-SECTION AND MASS OF WIRES (Continued)

U. S. Measure (Continued)

Diameters are given in mils (1 mil = .001 in.), and area in square mils (1 sq. mil = .000001 sq. in.). For sections and masses for one-tenth the diameters given, divide by 100 and for sections and masses for ten times the diameter multiply by 100.

Diam. in mils.	Cross-sec. in sq. mils.	Pounds per foot.			
		Copper, density 8.90.	Iron, density 7.80.	Brass, density 8.56.	Aluminum, density 2.67.
55	2375.83	0.009167	0.008034	0.008817	0.002750
56	2463.01	09504	08329	09140	2851
57	2551.76	09846	08629	09470	2954
58	2642.08	10195	08934	09805	3058
59	2733.97	10549	09245	10146	3165
60	2827.43	0.01091	0.00956	0.01049	0.003273
61	2922.47	1128	0988	1085	3383
62	3019.07	1165	1021	1120	3495
63	3117.25	1203	1054	1157	3608
64	3216.99	1241	1088	1194	3724
65	3318.31	0.01280	0.01122	0.01231	0.003841
66	3421.19	1320	1157	1270	3960
67	3525.65	1360	1192	1308	4081
68	3631.68	1401	1228	1348	4204
69	3739.28	1443	1264	1388	4328
70	3848.45	0.01485	0.01302	0.01429	0.004456
71	3959.19	1528	1339	1469	4583
72	4071.50	1571	1377	1511	4713
73	4185.39	1615	1415	1553	4845
74	4300.84	1660	1454	1596	4978
75	4417.86	0.01705	0.01494	0.01639	0.005114
76	4536.46	1751	1534	1684	5251
77	4656.63	1797	1575	1728	5390
78	4778.36	1844	1616	1773	5531
79	4901.67	1892	1658	1819	5674
80	5026.55	0.01939	0.01700	0.01865	0.005818
81	5153.00	1988	1743	1912	5965
82	5281.02	2038	1786	1960	6113
83	5410.61	2088	1830	2008	6263
84	5541.77	2138	1874	2057	6415
85	5674.50	0.02189	0.01919	0.02106	0.006568
86	5808.80	2241	1964	2156	6724
87	5944.68	2294	2010	2206	6881
88	6082.12	2347	2057	2257	7040
89	6221.14	2400	2104	2309	7201
90	6361.73	0.02455	0.02151	0.02360	0.007364
91	6503.88	2509	2199	2414	7528
92	6647.61	2565	2248	2467	7695
93	6792.91	2621	2297	2521	7863
94	6939.78	2678	2347	2575	8033
95	7088.22	0.02735	0.02397	0.02630	0.008205
96	7238.23	2793	2448	2686	8378
97	7389.81	2851	2499	2742	8554
98	7542.96	2910	2551	2799	8731
99	7697.69	2970	2603	2857	8910
100	7853.98	0.03030	0.02656	0.02915	0.009091

CROSS-SECTION AND MASS OF WIRES (Continued)

Metric Measure

Diameters are given in thousandths of a centimeter and area of section in square thousandths of a centimeter. $1\ (\text{cm.}/1000)^2 = .000001$ sq. cm. For sections and masses for diameters 1/10 or 10 times those of the table, divide or multiply by 100.

Diam. in thousandths of a cm.	Cross-section in square thousandths of a cm.	Grams per meter.			
		Copper, density 8.90.	Iron, density 7.80.	Brass, density 8.56.	Aluminum, density 2.67.
10	78.54	0.06990	0.06126	0.06723	0.02097
11	95.03	.08458	.07412	.08135	.02537
12	113.10	.10065	.08822	.09681	.03020
13	132.73	.11813	.10353	.11362	.03544
14	153.94	.13701	.12008	.13177	.04110
15	176.71	0.1573	0.1378	0.1513	0.04718
16	201.06	.1789	.1568	.1721	.05368
17	226.98	.2020	.1770	.1943	.06060
18	254.47	.2265	.1985	.2178	.06794
19	283.53	.2523	.2212	.2427	.07570
20	314.16	0.2796	0.2450	0.2689	0.08388
21	346.36	.3083	.2702	.2965	.09248
22	380.13	.3383	.2965	.3254	.10149
23	415.48	.3698	.3241	.3557	.11093
24	452.39	.4026	.3529	.3872	.12079
25	490.87	0.4369	0.3829	0.4202	0.1311
26	530.93	.4725	.4141	.4545	.1418
27	572.56	.5096	.4466	.4901	.1529
28	615.75	.5480	.4803	.5271	.1644
29	660.52	.5879	.5152	.5654	.1764
30	706.86	0.6291	0.5514	0.6051	0.1887
31	754.77	.6717	.5887	.6461	.2015
32	804.25	.7158	.6273	.6884	.2147
33	855.30	.7612	.6671	.7321	.2284
34	907.92	.8081	.7082	.7772	.2424
35	962.11	0.856	0.7504	0.8236	0.2569
36	1017.88	.906	.7939	.8713	.2718
37	1075.21	.957	.8387	.9204	.2871
38	1134.11	1.012	.8866	.9730	.3035
39	1194.59	.063	.9318	1.0230	.3190
40	1256.64	1.118	0.980	1.076	0.3355
41	1320.25	.175	1.030	.130	.3525
42	1385.44	.233	.081	.186	.3693
43	1452.20	.292	.133	.243	.3877
44	1520.53	.353	.186	.302	.4060
45	1590.43	1.415	1.241	1.361	0.4246
46	1661.90	.479	.296	.423	.4437
47	1734.94	.544	.353	.485	.4632
48	1809.56	.611	.411	.549	.4832
49	1885.74	.678	.471	.614	.5035
50	1963.50	1.748	1.532	1.681	.5243
51	2042.82	.818	.593	.753	.5454
52	2123.72	.890	.657	.818	.5670
53	2206.18	.964	.721	.888	.5891
54	2290.22	2.038	.786	.960	.6115

CROSS-SECTION AND MASS OF WIRES (Continued)

Metric Measure (Continued)

Diameters are given in thousandths of a centimeter and area of section in square thousandths of a centimeter. 1 (cm./1000)² = .000001 sq. cm. For sections and masses for diameters 1/10 or 10 times those of the table divide or multiply by 100.

Diam. in thousandths of a cm.	Cross-section in square thousandths of a cm.	Grams per meter.			
		Copper, density 8.90.	Iron, density 7.80.	Brass, density 8.56.	Aluminum density 2.67.
55	2375.83	2.114	1.853	2.034	0.6343
56	2463.01	192	.921	.108	.6576
57	2551.76	.271	.990	.184	.6813
58	2642.08	.351	2.061	.262	.7054
59	2733.97	.433	.132	.340	.7300
60	2827.43	2.516	2.205	2.420	0.7549
61	2922.47	.601	.280	.502	.7803
62	3019.07	.687	.355	.584	.8061
63	3117.25	.774	.431	.668	.8323
64	3216.99	.863	.509	.760	.8589
65	3318.31	2.953	2.588	2.840	0.8860
66	3421.19	3.045	.669	.929	.9135
67	3525.65	.138	.750	3.018	.9413
68	3631.68	.232	.833	.109	.9697
69	3739.28	.328	.917	.201	.9984
70	3848.45	3.426	3.003	3.295	1.028
71	3959.19	.524	.088	.389	.057
72	4071.50	.624	.176	.485	.087
73	4185.39	.725	.265	.583	.117
74	4300.84	.828	.355	.682	.148
75	4417.86	3.932	3.446	3.782	1.180
76	4536.46	4.037	.538	.883	.211
77	4656.63	.144	.632	.986	.243
78	4778.36	.253	.727	4.090	.276
79	4901.67	.362	.823	.177	.309
80	5026.55	4.474	3.921	4.303	1.342
81	5153.00	.586	4.019	.411	.376
82	5281.02	.700	.119	.521	.410
83	5410.61	.815	.220	.631	.445
84	5541.77	.932	.323	.744	.480
85	5674.50	5.050	4.426	4.857	1.515
86	5808.80	.170	.531	.972	.551
87	5944.68	.291	.637	5.089	.587
88	6082.12	.413	.744	.206	.624
89	6221.14	.537	.852	.325	.661
90	6361.73	5.662	4.962	5.446	1.699
91	6503.88	.788	5.073	.567	.737
92	6647.61	.916	.185	.690	.775
93	6792.91	6.046	.298	.815	.814
94	6939.78	.176	.413	.940	.853
95	7088.22	6.309	5.529	6.068	1.893
96	7238.23	.442	.646	.196	.933
97	7389.81	.577	.764	.326	.973
98	7542.96	.713	.884	.457	2.014
99	7697.69	.851	6.004	.589	.055
100	7853.98	6.990	6.126	6.722	2.097

APPROXIMATE RESISTANCE OF WIRES

Giving the resistance in ohms of one centimeter length at 20°C. Owing to varying composition and physical condition, these values can be considered only as approximations.

Gauge No. B. & S.	Diam. in cms.	Brass	Constantin	German silver	Iron	Manganin
10	.2588	.00014	.00093	.00056	.00023	.00080
12	.2053	.00023	.00148	.00089	.00036	.00127
14	.1628	.00037	.0024	.00142	.00058	.0020
16	.1291	.00058	.0037	.0023	.00092	.0032
18	.1024	.00091	.0059	.0036	.00146	.0051
20	.08118	.00147	.0095	.0057	.0023	.0081
22	.06438	.0023	.0150	.0090	.0037	.0129
24	.05106	.0037	.024	.0144	.0059	.021
26	.04049	.0059	.038	.023	.0093	.033
27	.03606	.0075	.048	.029	.0118	.041
28	.03211	.0093	.061	.036	.0148	.052
30	.02546	.0147	.096	.058	.024	.083
32	.02019	.024	.153	.092	.038	.131
34	.01601	.038	.24	.148	.060	.209
36	.01270	.060	39	.23	.094	.33
40	.00799	.15	.98	.59	.24	.84

PROBLEMS

THE METHOD OF SOLVING CHEMICAL PROBLEMS

(From Talbot's Quantitative Analysis, by permission.)

Detailed solutions of a few typical problems are given below The student should study these carefully, and assure himself tha they are fully understood.

1. A "chemical factor" expresses the ratio between a specifi quantity of a chemical compound and the *equivalent* quantity o some other body. For example, if it is wished to determine th weight of sulphur which corresponds to a specific weight of barium sulphate, the latter is multiplied by the factor, or ratio, repre sented by the fraction $\frac{S}{BaSO_4}$, or $\frac{32.07}{233.50} = 0.1373$. It may also be expressed by the proportion $\overset{233.5}{BaSO_4} : \overset{32.07}{S} =$ wt. $BaSO_4 : x$, from which it is plain that $x = \frac{32.07}{233.50} \cdot$ wt. $BaSO_4$.

Again, if the weight of FeO in Fe_2O_3 is desired, the factor becomes $\frac{2\,FeO}{Fe_2O_3} = \frac{144.04}{160.04} = 0.9000$. Similarly, the factor for the conversion of KCl to K_2O is $\frac{K_2O}{2\,KCl} = \frac{94.22}{149.12} = 0.6320$. The logarithmic equivalents of these values are called log factors.

In the calculation of these factors, the atomic or molecular relations of the two substances must be kept clearly in mind thus, it is plainly *incorrect* to express the ratio of ferrous to ferric oxide by the fraction $\frac{FeO}{Fe_2O_3}$, since each molecule of the higher oxide must correspond to two molecules of the lower. Carelessness in this respect is one of the most frequent sources of error.

2. To calculate the volume of a reagent required for a specific operation, it is necessary to know the exact reaction which is to be brought about, and, as with the calculation of factors, to keep in mind the molecular relations between the reagent and the substance reacted upon. For example, to estimate the weight of barium chloride necessary to precipitate the sulphur from 0.1 gram of pure pyrite (FeS_2), the proportion should stand $\overset{488.70}{2BaCl_2 . 2\,H_2O} : \overset{120.16}{FeS_2} = x : 0.1$, where x represents the weight of the chloride

"Talbot's "Quantitative Analysis."

required. Each of the two atoms of sulphur will form a molecule of sulphuric acid upon oxidation, which, in turn, will require a molecule of the barium chloride for precipitation. To determine the quantity of the barium chloride required, it is necessary to include in its molecular weight the water of crystallization, since this is inseparable from the chloride when it is weighed. This applies equally to other similar instances.

If the strength of an acid is expressed in percentage by weight, due regard must be paid to its specific gravity. For example, hydrochloric acid (sp. gr. 1.12) contains 23.8 per cent HCl by weight; *i.e.*, 0.2666 gram.

3. No rules for universal application to "indirect gravimetric analyses" can be laid down. A single example will be explained.

Given a mixture of KCl + NaCl weighing 0.15 gram, which contains 53 per cent chlorine, to calculate the weight of KCl and NaCl in the mixture.

The weight of chlorine in the mixture is (0.15×0.53) or 0.0795 gram. Assuming that this chlorine was all in combination with potassium, the corresponding weight of KCl would be 0.1672 gram (Cl : KCl = 0.0795 : 0.1672). This is an excess of 0.0172 gram over the actual weight of the mixture, and it is plain that this difference is occasioned by the replacement of certain of the molecules of potassium chloride, weighing 74.56 units, by molecules of sodium chloride weighing 58.50 units. To express this, let it be supposed that the mixture is made up of n molecules $\overset{74.56}{\text{KCl}}$ and n' molecules NaCl; then it may be said that $n\ \overset{74.56}{\text{KCl}} + n'\ \overset{58.50}{\text{NaCl}} = 0.15$ gram, and $n\ \overset{74.56}{\text{KCl}} + n'\ \overset{74.56}{\text{KCl}} = 0.1672$ gram, then by subtracting the first equation from the second it is shown that $n'\ (\overset{74.56}{\text{KCl}} - \overset{58.50}{\text{NaCl}}) = 0.0172$ gram. That is, the difference in weight is equal to n' times the difference in the molecular weights of the two chlorides. The actual weight of NaCl present (x) is equal to $58.50n'$, or, since $n' = \frac{0.0172}{74.56 - 58.50}$, $x = 58.50\left(\frac{0.0172}{74.56 - 58.50}\right)$. This may be expressed in the form $(74.56 - 58.50) : 58.50 = 0.0172 : x$, from which $x = 0.0626$. The weight of NaCl subtracted from that of the mixture gives the weight of KCl.

The weights of the chlorides may also be calculated algebraically by solving the equations $x + y = 0.15$ and $\frac{35.45}{74.56}x + \frac{35.45}{58.50}y = 0.0795$, where x is the weight of KCl and y is the weight of NaCl in the mixture.

4. It is sometimes desirable to weigh out such a quantity of substance for analysis, that the number of cubic centimeters of standard solution entering into the reaction shall represent directly the percentage of the desired constituent. This may be readily done, by considering the relation of the solution to a normal solution and the atomic or molecular weight of the desired component. For example, suppose it is desired to calculate such a weight for K_2CO_3 in pearl ash, when a half-normal acid solution

is used. Since half-normal acid and alkali solutions are equivalent, and since by definition the half-normal K_2CO_3 solution contains 34.55 grams per liter, each cubic centimeter of the acid solution must be equivalent to 0.03455 gram K_2CO_3. Hence, 100 cc. would neutralize 3.455 grams pure K_2CO_3 and this becomes the desired weight of the pearl ash. Similarly the required weight of limonite where the iron (Fe) is to be determined by means of a deci-normal $K_2Cr_2O_7$ solution is 0.5602 gram.

5. One of the most frequently recurring cases in volumetric analysis is that in which it is wished to express the value of a specific solution in terms of some substance other than that against which it has been standardized as for instance, the value of a permanganate solution which has been standardized against oxalic acid, in terms of iron. Although such problems apparently vary widely, there are common principles which can be applied to them all. These are stated below, and the student should assure himself that they are fully understood.

Suppose, for example, it is desired to find the iron value (Fe) of a permanganate solution, of which 1 cc. is equivalent to 0.006302 gram $C_2H_2O_4 \cdot 2H_2O$.

From a comparison of the reactions it is seen that 10 molecules of ferrous sulphate and 5 molecules of oxalic acid each react with the same amount (2 molecules) of the permanganate. These two quantities being, then, equivalent to the same third quantity, must be equivalent to each other; in other words, 10 molecules of ferrous sulphate and 5 molecules of oxalic acid have the same reducing power. But, as stated above, the value is desired in terms of metallic iron (Fe), not $FeSO_4$, but as it is plain that $10FeSO_4$ are equivalent to 10Fe, it is proper to make the proportion

$$\overset{560.2}{10\,Fe} : \overset{630.25}{5C_2H_2O_4 \cdot 2H_2O} = x : 0.006302$$

in which $x = 0.005602$ gram. Here, again, as in example 2, it is necessary to include the water of crystallization in the molecular weight of the oxalic acid, as it is weighed with it.

The same conclusion is arrived at, if we consider the relation of the solution to the normal. As given, it is deci-normal and must, therefore, be equivalent to a deci-normal solution of iron. From the equations cited, it is seen that $10FeSO_4$, unite with 5O, therefore each molecule is equivalent to 1 hydrogen atom in reducing power. The normal solution must, then, contain 1 gram-molecule of ferrous sulphate, or 56.02 grams Fe, and each cubic centimeter of the deci-normal solution would contain 0.005602 gram, the value obtained above.

Again, suppose the value of the same permanganate solution were desired in terms of molybdenum (Mo), the reactions with permanganate being

$$5Mo_{12}O_{19} + 17Mn_2O_7 = 60MoO_3 + 34MnO, \text{ and}$$
$$5C_2H_2O_4 \cdot 2H_2O + Mn_2O_7 = 2MnO + 10CO_2 + 15H_2O.$$
(Mn_2O_7 is the anhydride of $HMnO_4$.)

It is plain that in these equations as they stand, the molecular quantities of oxidizing agent are not equal. They can be made so by simply multiplying the second equation by 17, and they then become,

$$5Mo_{12}O_{19} + 17Mn_2O_7 = 34MnO + 60MoO_3, \text{ and}$$
$$85C_2H_2O_4 \cdot 2H_2O + 17Mn_2O_7 = 34MnO + 170\ CO_2 + 255\ H_2O.$$

It is now possible to reason in the same way as before, and to conclude that 85 molecules of the oxalic acid have the same reducing power as 5 molecules of the oxide $Mo_{12}O_{19}$, or 60 atoms of molybdenum. Accordingly,

$$\overset{5758.8}{60Mo} : \overset{10714.25}{85C_2H_2O_4.2H_2O} :: x : 0.006302$$

in which x 0.003387 gram.

Since $5Mo_{12}O_{19}$ unite with 85O, a normal solution of the former as a reducing agent, would contain 1/170 of the 5 gram-molecules or 33.87 grams Mo, and the deci-normal solution 3.387 grams per liter. This agrees with the values already obtained.

6. It is sometimes necessary to calculate the value of solutions according to the principles just explained, when several successive reactions are involved. Such problems may be solved by a series of proportions, but it is usually possible, after stating these to eliminate the common factors and solve but a single one.

For example, suppose it is desired to express the value of a permanganate solution, of which 1 cc. = 0.008 gram iron (Fe), in terms of calcium oxide (CaO). The reactions involved in the volumetric determination of calcium are the following; $CaCl_2 + (NH_4)_2C_2O_4 = CaC_2O_4 + 2NH_4Cl$; $CaC_2O_4 + H_2SO_4 + 2H_2O = CaSO_4 + C_2H_2O_4 \cdot 2H_2O$; $5C_2H_2O_4 \cdot 2H_2O + 2KMnO_4 + 3H_2SO_4 = K_2SO_4 + MnSO_4 + 10CO_2 + 18H_2O$.

From the considerations stated under 5, the following proportions may be made.

$$10Fe : 5C_2H_2O_4 \cdot 2H_2O = 0.008 : x$$
$$5C_2H_2O_4 \cdot 2H_2O : 5CaC_2O_4 = x : y$$
$$5CaC_2O_4 : 5CaO = y : x$$

Canceling the common factors, there remains simply

$$\overset{560.2}{10Fe} : \overset{280.4}{5\ CaO} = 0.008 : z$$

Similarly, from the reactions, the equivalent of the iodine liberated may be calculated in terms of MnO_2 as follows: Supposing the weight of iodine to be 0.5 gram then

$$2I : 2KI = 0.5 : x$$
$$2KI : 2Cl = x : y$$
$$2Cl : 2HCl = y : z$$
$$2HCl : MnO_2 = z : w$$

Canceling the common factors, there remains

$$2I : MnO_2 = 0.5 : w$$

To solve such problems as 5 and 6, it is necessary to know the reactions involved, and the way in which the various components break up; then to compare the reactions and to search for those molecular quantities of the compounds in question, which are *equivalent* in their action upon a common agent. Having found these, as shown above, express the molecular ratio between them in the form of a proportion; as, for example, $\overset{253.7}{2\,I} : \overset{86.99}{MnO_2} = 0.5 : w$. Expressed in the form $w = \frac{86.99}{253.7}\,0.5$, it is plain that this ratio is in no way different in principle from the chemical factor mentioned in paragraph 1; indeed, it is the factor for the conversion of iodine to manganese dioxide.

PROBLEMS IN ELEMENTARY PHYSICS

1. A map is drawn to the scale 1 mile to the inch. What area on the map in square centimeters represents 10 square miles? Ans. 64.5 sq.cm.

2. Express a velocity of 2500 cm. per second in feet per minute. Ans. 4921.2 feet per minute.

3. A rectangular tank 15 cm.×163 mm.×6 meters, inside measurements, is filled with water. Express the mass of the water in kilograms. One c.cm. of water weighs 1 gram (approximately). Ans. 146.7 kg.

4. The radius of a circle is 12 cm., what is the angle in degrees subtended by an arc of 16 cm.? Ans. 76.39°.

5. The pitch of the screw in a micrometer caliper is 0.5 mm.; the rotating head of the instrument carries 50 divisions; the vernier of the shank over which the head turns has 10 divisions which occupy the space of 9 smallest divisions on the head. What is the smallest distance which can be measured without estimation? Ans. 0.001 mm.

6. How far from the point of observation must a scale be placed in order that 1 cm. on the scale will subtend an angle of 1 minute? Ans. 3438 cm.

7. A river is 1 kilometer in width, and the current has a velocity of 4 km. per hour. What direction must be taken by a launch moving at 8 km. per hour in order to land directly opposite the starting point? What will be the total time for the trip? Ans. The launch must steer 30° upstream; 8.7 minutes.

8. A pendulum having a period of 1 second and a pendulum of nearly the same period are arranged so that it is possible to observe when the two reach the mid point of their respective oscillations at the same instant going in the same direction. The time elapsing between coincidences is 106 seconds. If the unknown is shorter than the known pendulum, what is its period? Ans. 0.9906 sec.

9. A body starts from rest and moves for 10 seconds with a uniform acceleration of 5 cm./sec.^{2}, for the next 20 seconds it moves uniformly at the velocity acquired and is finally brought to rest with a uniform acceleration of −5. cm./sec.^{2}, what is

the total space covered and the time occupied? Ans. 1500 cm., 40 sec.

10. Find the value of a constant force which, acting on a mass of 500 grams for 2 seconds, produces an increase in velocity of 10 cm./sec. Ans. 2500 dynes.

11. What is the weight in dynes of a sphere whose mass is 100 grams? If a spherical mass of 1000 kg. is placed vertically beneath the body so that their centers are separated by a distance of 50 cm., what is the apparent increase in weight? (g. = 980. cm./sec.^{2}, the gravitational constant $=6.66\times10^{-8}$, C. G. S.) Ans. 98,000 dynes; .0026 dyne.

12. A uniform bar, 100 cm. long, is supported on a knife edge 30 cm. from one end. A mass of 500 g. is suspended at a distance of 5 cm. and a mass of 200 g. at a distance of 60 cm from the same end. If the system is in equilibrium, what is the mass of the bar? Ans. 325 g.

13. The beam of a balance is 25 cm. long and weighs 50 g. If the center of gravity is 0.05 cm. below the central knife edge through what angle will the beam be deflected by the addition of 0.001 gram to one of the pans? Ans. 0° 17.2′.

14. The mean radius of the earth is about 6,370,000 meters. What is the acceleration toward the center of a point on the equator due to the rotation of the earth? Ans. 2910.3 meters per sec. per sec.

15. If the period of simple harmonic motion is 10 seconds and the amplitude 20 cm., what is the displacement, velocity and acceleration 2 seconds after the particle has passed its mid point in a positive direction? Ans. Displacement 19.02 cm., velocity 3.88 cm./sec., acceleration -7.51 cm./sec.^{2}.

16. A body of 60 g. mass falls freely from rest for 6 seconds, what is its momentum and kinetic energy at the end of the period? (g. = 980 cm./sec.^{2}.) How far does the body fall? How much work would be done in raising it to its original position? Ans. Momentum, 352,800 g. cm./sec.; kinetic energy, 1.037×10^9 ergs; space passed over 17,640 cm.; potential energy (mgh) 1.037×10^9 ergs.

17. What power is delivered by a hoisting engine in pulling a mass of 200 kg., (1) Upward against gravity, 5 meters per second; (2) along a horizontal plane whose coefficient of friction with the block is 0.20 at the rate of 2 meters per second; (3) along a perfectly smooth (frictionless) horizontal plane at any velocity; (4) up an incline of 45° with the horizontal with a coefficient of friction of 0.1 at the rate of 1 meter (measured along the incline) per second? (The hoisting apparatus is to be considered frictionless.) Ans. (1) 980 watts. (2) 784 watts. (3) No work is done. (4) 15,240 watts.

18. A bullet fired from a gun 1 cm. in internal diameter and 75 cm. long has a muzzle velocity of 500 meters per second. What uniform pressure in the barrel would cause this velocity if the bullet weighs 25 g.? Ans. 1.061×10^9 dynes per sq. cm.

19. The pitch of a jack screw is 1 cm; the power is applied at the end of a lever 24 cm. long. When force of 30,000 dynes is applied at the lever the lifting force is 1,200,000 dynes, what

portion of the force applied is used to overcome friction? What is the efficiency? Ans. 22,040 dynes; 34.1%.

20. It is required to find the density of a cylinder of alloy. A ballast load is placed on one pan of the balance, which requires 292.560 g. to counterbalance. The sample is added to the pan containing the weights and the amount to effect equilibrium is reduced to 88.480 g. When the sample is suspended below the pan in water (density 0.9977) the mass necessary in the pan is 148.627 g. The density of the brass weights was 8.45, the density of air at the temperature and pressure of the experiment 0.00115. Find the true density, making correction for buoyancy of the air. Ans. 3.383.

21. The cross-section of the stem of an hydrometer has an area of 0.2 sq.cm. The total volume immersed when the instrument floats in water at 4° C. is 6. cu.cm. If in another liquid the hydrometer sinks until 8 cm. additional length of stem is immersed, what is the specific gravity the liquid? Ans. 0.7894.

22. The volume of the cylinder of an air pump cleared at each stroke of the piston is 2000 cc. If the volume of the vessel to be exhausted with connecting tubes is 4000 cc., what pressure should be obtained by 10 strokes? Ans. 0.0173 the original pressure.

23. Water at a temperature of 20.3° C. rises to a height of 6.128 cm. in a tube whose radius is 0.0247. Compute the surface tension, taking g.=980. Ans. 74.15 dynes/cm.

24. A glass tube closed at one end is 100 cm. long. A column of mercury 91 cm. long is poured into the tube and it is then inverted with the lower (open) end in a dish of mercury. The air now fills 40 cm. at the top of the tube and a column of mercury 58 cm. long is supported below. What is the barometric pressure? Ans. 74.84 cm.

25. A wire 100 cm. long and 0.3 mm. in radius is stretched 2 mm. by the addition of a weight of 10 kilos. Compute the value of Young's Modulus. Ans. 17.3×10^{11} dynes/sq.cm.

26. The thermal coefficient of linear expansion of brass is 0.000018. A cylindrical bar is 100 cm. long at 20° C. and has a density of 8.450, what is the length and density at 0° C. Ans. Length 99.964 cm., density 8.451 g./cm.^{3}.

27. A steel rod is measured with a brass scale at 15° C. The rod appears to be 200 cm. long. The scale is correct at 0° C. What is the true length of the rod at 0°? The coefficient of expansion for steel is .000011. Ans. 200.021 cm.

28. If the volume of a portion of gas is 1000 ccm. under pressure of 30.5 cm. of mercury and at a temperature 0° C. what will be the volume under a pressure of 29.5 cm. and temperature of 20° C.? Ans. 1109 c. cm.

29. The mass of a copper calorimeter is 110 grams. It contains 400 grams of water at a temperature of 16° C. A solid mass of 60 grams at a temperature of 98° C. is placed in the water. The temperature reaches equilibrium at 21° C. Neglecting radiation, find the specific heat of the solid. Ans. 0.443 cal./g.

30. Two hollow brass cones fit together and are arranged so that the outer cone can be rotated while the inner cone may be held stationary by the application of a force sufficient to overcome the friction between the cones. A horizontal pulley 30 cm. in diameter is attached to the inner cone and a cord wrapped around this pulley and passing over another pulley at the side supports a weight of 100 grams. The mass of the two cones is 400 g., and 25 cc. of water is placed in the inner cone. The outer cone is rotated rapidly enough to keep the weight suspended and makes 1500 revolutions. What temperature change will occur in the cones, neglecting radiation? (The mechanical equivalent of heat is 4.18×10^7 ergs.) Ans. 5.33° C.

31. A source of sound whose frequency is 2000 per sec. is moving toward the observer at the rate of 7200 kilometers per hour. The temperature of the air is 20° C. What is the apparent pitch? Ans. 2116.4 per sec.

32. What are the relative potentials of two insulated conducting spheres charged with equal quantities of electricity if their radii are 5 and 10 cm. respectively? Ans. 2 to 1.

33. What is the force acting between two concentrated positive charges of 6 and 8 units, separated by a distance of 4 cm. in air? Ans. 3 dynes.

34. What is the resistance of 48,500 cm. of copper wire 1 millimeter in diameter at 0° C.? The specific resistance of copper is .0000017. Ans. 0.26 ohm.

35. A circuit is composed of 8 cells in two groups. The two groups are in parallel and each consists of 4 cells in series. The electromotive force of each cell is 1.4 volts and the internal resistance 0.1 ohm. The external circuit consists of a series of 5 coils, each having a resistance of 200 ohms. If a galvanometer whose resistance is 1000 ohms is placed in parallel with one of the coils, what current will flow through the galvanometer? Ans. 0.00096 amp.

36. A cell whose electromotive force is 1 volt and internal resistance 5 ohms is connected in series with a resistance of 2000 ohms and a galvanometer whose resistance is 98 ohms. The galvanometer terminals are connected by a shunt having a resistance of 1 ohm and the scale is 25 cm. from the mirror. The deflection, observed by a telescope, is 0.55 cm. What is the figure of merit—that is, the current which would cause a scale deflection of 1 mm. if the scale were 1 meter from the mirror? Ans. 0.000000229 amp.

37. The horizontal intensity of the earth's magnetism at a certain locality is 0.20 gauss and the dip is 70°; what is the value of the total intensity? Ans. 0.585 gauss.

38. A standard candle and an electric incandescent of unknown intensity are 500 cm. apart. A photometer screen shows even illumination when placed 100 cm. from the candle. The standard candle is found to have consumed spermaceti at the rate of 124 grains per hour during the test. If the intensity of the candle is 1 international candle when burning 120 grains per hour, what is the horizontal candle power of the unknown? Ans. 15.47 international candles.

39. An object 43.6 cm. from a concave spherical mirror gives a sharp image 66.5 cm. from the mirror; find the principal focus and radius of curvature of the mirror. Ans. Focus 26.33 cm., radius of curvature, 52.6 cm.

40. Light divergent from a point source 20.5 cm. from a double concave lens has its divergence increased by the lens so that it appears to come from a point 113.9 cm. from the lens (on the same side as the source). The radius of curvature of both faces is 25.1 cm., what is the principal focus and index of refraction of the lens? Ans. Principal focus −25.0 cm.; index of refraction 1.50.

41. The angle of minimum deviation of a prism is observed and found to be 60° 2.5′. If the angle of the prism is 59° 54′, what is the index of refraction of the material of the prism? Ans. 1.734.

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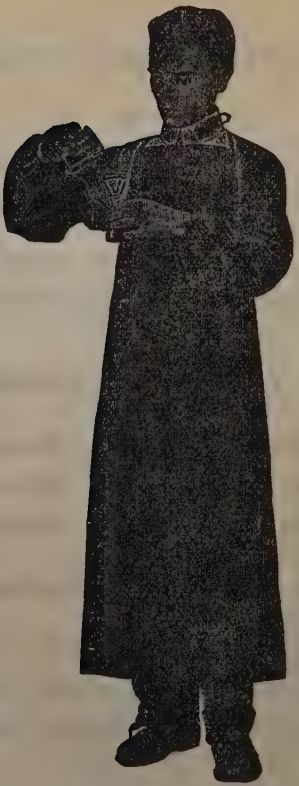

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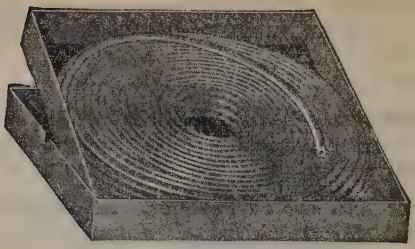

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Wall, in.	1/32	3/64	1/16	5/64	3/32
Approx. ft. per lb.	65	35	24	14	10

Inside diam. in.	1/2	5/8	3/4	1
Wall, in.	7/64	1/8	9/64	5/32
Approx. ft. per lb.	5	4	2 1/2	2

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Wall, in.	5/64	3/32	7/64
Approx. ft. per lb.	32	16	11

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Wall, in.	1/8	1/8	1/8
Approx. ft. per lb.	8	7	5

Grade 508 RUBBER TUBING — Pure Gum Red Antimony, of the finest selected crude rubber treated by the most improved methods.

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Wall, in.	5/64	3/32	7/64
Approx. ft. per lb.	20	10	8

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Wall, in.	1/32	11/64	3/64	1/16	5/64
Approx. ft. per lb.	130	80	64	40	25
Inside diam. in.	3/8	1/2	5/8	3/4	1
Wall, in.	3/32	7/64	1/8	9/64	5/32
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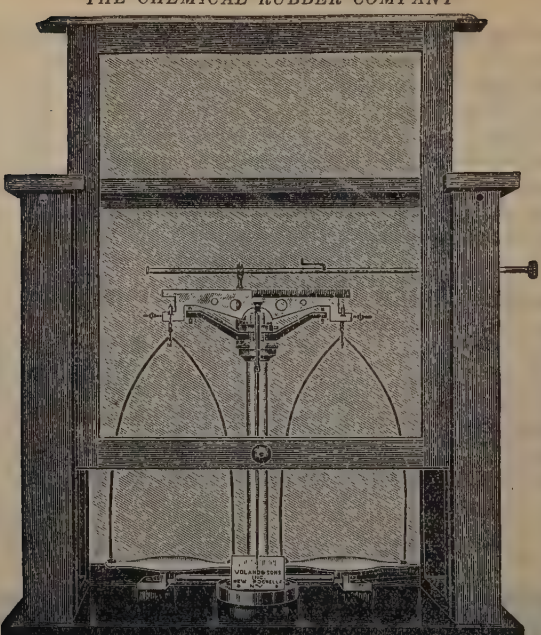
0	16mm	12mm	82	84	85
1	18mm	14mm	59	64	68
2	20mm	16mm	53	55	57
3	23mm	18mm	39	41	43
4	25mm	20mm	32	34	36
5	27mm	23mm	26	28	29
6	32mm	26mm	20	21	22
7	36mm	30mm	15	15	16
8	40mm	33mm	12	12	13
9	45mm	37mm	10	10	10
10	50mm	42mm	8	8	8
11	56mm	50mm	6	6	6
12	65mm	58mm	4	4	4
13	70mm	60mm	3	3	3



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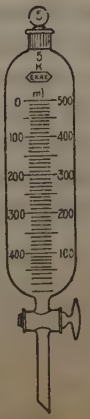

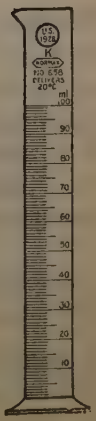

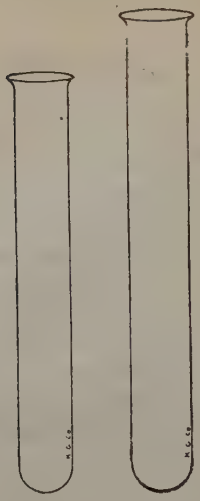

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